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Indiana Agricultural Experiment Station.

C. S. PLUMB, Director.

LaFayette, Ind. Bulletin No. 91, Vol. XI, January, 1902.

The preceding bulletin was No. 90, October, 1901, incorrectly paged.

The Modern Silo.

BY C. S. PLUMB.

In June, 1892, a bulletin of 20 pages was prepared by the writer and published by this Station, under the title, "The silo and silage in Indiana." This bulletin contained information on silo construction, crops for silage and brief experimental results in feeding silage at this and other stations. Reports were also given from 35 persons in the State who had used or were then using silos; the oldest one reported in use being that of Mr. C. B. Harris of Goshen, who adopted the silo in 1885. Of the 35 persons reporting, only one had made use of the round form.

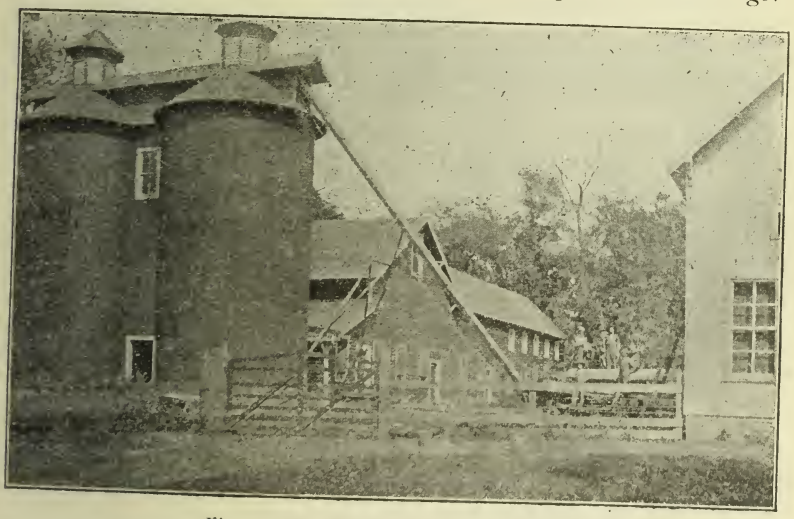

Fig. 1. Wisconsin silos of Dr. Thompson.

Since the publication of this bulletin in 1892, a great advancement has taken place in silo construction. At the present time, nearly all of the silos made are circular in form, prominent among which is the stave of tub type. In 1892 perhaps not over 50 persons at the outside owned silos in the state. Today there are many in the dairy districts, and just at present the subject of silo construction is attracting much interest among farmers. It is to supply the demand for this information, that this bulletin is published for the special assistance of Indiana farmers desiring suggestions on silo construction.

Previous to 1898 at the Indiana Station the silos in use consisted of two small square ones in the cattle barn where they were constructed in 1889. These were each 15 feet square and 20 feet deep and held about 60 tons each.

The square silo, however, does not represent the most economical or desirable construction. There are corners in which the silage does not always pack satisfactorily, and where losses through decay very often occur. Further, the square or rectangular wooden silo often weakens with age, and spreads at the sides, and consequently the silage ruined by the entrance of air at these weak points. This defective feature of the straight-sided silo, led to the adoption a dozen or so years ago of the circular or round silo.

The round silo has two distinct advantages.

First—There are no corners in which decay may develop.

Second—The pressure is equally distributed from the center to each side, so that there is no unequal strain upon the walls or sides of the silo of this form, while the pressure from above on the silage below is uniformly distributed.

These advantages have been found to be so distinct and important that at this time but comparatively few silos are built, excepting of the circular form.

There are several types of silos that it is proposed to discuss in this bulletin, each of which has its advantages and disadvantages, and many of the wooden forms of each have been constructed and are used with general satisfaction.

Wisconsin Round Silo.

In the summer of 1891, the Wisconsin Experiment Station published a bulletin (No. 28) on the construction of silos, in which the first detailed or illustrated description of a round silo was given in a station bulletin. The recommendations given in this bulletin no doubt resulted in the construction of a large number of

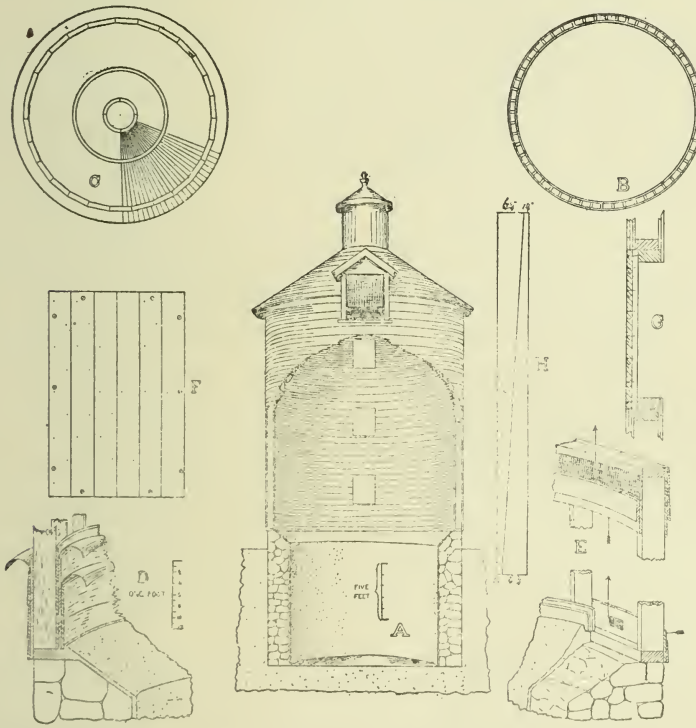

Fig. 2. *Diagram showing construction of Wisconsin Silo, after King.* A, general view. B, shows placing of studding. C, underside of roof, looking up. Rafters are not used for conical roofs, but circles instead, made by bending and nailing together strips of half inch lining, making a hoop or circular plate 4 inches thick, as shown in C. Roof boards in C and H are made by cutting 8-inch common boards in two diagonally. D, shows wall, with studs, sheeting, paper between and where cement and wall joint. E, shows method of ventilation. F and G shows construction of feeding doors, which open inside. Filling door should be three feet wide to allow for a man to enter by side of carrier or blower.

round silos, based on the description given by Professor King. This silo is so admirable in character that it is thought best to briefly give its construction herewith. The illustration on the first page is of a pair of silos of this type on the farm of Dr. Thompson near Indianapolis. Figure 2 is reproduced by courtesy of the Wisconsin Station.

The foundation may be marked out by driving a stake in the ground at the center of the desired site, driving on level ground to the height of the desired wall. A nail should then be driven in the top of the stake. Next take a straight-edged stick of convenient material, plenty long enough to measure more than half the diameter of the proposed silo. Bore a hole in one end of the stick, so that it may neatly slip over the nail, and saw the other end off, so that it may describe a circle when turned on the stake, equal to the size of the silo. If desired, the outer end of the stick may represent the outer circle of the wall and a mark on the stick at suitable distance, the inner edge of wall.

The foundation may be made of stone, brick or concrete, and it is desirable to have it at least 12 inches above the ground, and two to three feet below the surface. In fact it will be well to have the silo in part below the ground, though not to a depth such as to make emptying difficult. Four or five feet below however, will not be unsatisfactory. The wall should be air-tight, with a thickness of one and one-half to two feet for silos 25 to 30 feet high.

Sill pieces of 2x4's should be cut in sections about two feet long and on the curve of the wall, bedded in mortar and toe-nailed together.

The studs should be of 2x4's and of length depending on depth of silo. A silo 28 feet deep can use studs 16 and 12 feet long to advantage. If four feet of wall is a part of the silo depth, then studs 14 and 10 feet long are desirable. The studs should be placed a foot apart from center to center, unless the silo is over 30 feet in diameter. This is to give a chance to keep the lining nailed close and to the curve of the circle. The studs should alternate in length, as for example a 16 feet length being nailed to the sill first, then a 12, then 16, etc. The upper line of studs will

of course alternate to bring the top on a common level. These studs may be held in place, by nailing a connecting strip on them and a post set in the center of the silo and five or six feet higher than the sill. Plumb each stud towards the center of the silo. After a number of studs have been set and toe-nailed flush to the front of the sill which lays against the outer side of the wall, plumbed and fastened by stays, they may be held together on the outside by a piece of sheeting nailed on temporarily as high up as a man can reach. In this way the first line of studs may be erected. Where the doors are to be located place an extra stud along side the studs to furnish sides to the doors, and space the door studs far enough apart to make a comfortable width, say 24 inches. Leave a stud standing between the double studs, at center of where the doors are to be. This can be cut out in door spaces later.

The sheeting should be made of first class lumber. Leave out black knots and shaky boards. No. 1 fencing ripped to form scant half-inch boards will do. Two inch planks sawed to make four boards is really a more profitable purchase of timber than using fencing.

Begin at bottom of studs in putting on the sheeting, working upward. Put on first a layer of sheeting around interior as high as can be conveniently reached by hand, and then begin the second layer, placing between the two a layer of first grade acid proof, tarred paper. Tack the paper on at intervals, and let the paper over-lap six or eight inches. See that the sheeting breaks joints by lapping half over the boards above and below it. Also nail sheeting so that each round will begin with the next stud beyond the one the previous course began with. Use two eight-penny nails in each board in each stud. Staging may be erected in the silo by little trouble on 2x4's, supported at the height desired by uprights, and cross planks nailed to 2x4's to make a serviceable working platform. Always keep the studs plumb and rigid for working on, and be sure that the rounds of sheeting are kept level in the courses, and are nailed close to the studs or under sheeting. Fig 2 at D. gives a sectional view, showing the

lapping of sheeting with the tarred paper between, this illustration being from bulletin 59 of the Wisconsin Station. The outside of this silo may be covered with a layer of lap siding to suit the circumstances. If the silo is over 18 feet in diameter, it is advised to first put on the studs a layer of half inch sheeting, and over this drop siding. If the silo is small, say 10 or 12 feet in diameter, then half-inch sheeting only can be used, as the heavier siding will not bend to the short curve of the small silo.

The plate is made similar to sill, from two foot pieces, sawed to the curve and spiked to the top of studs. The top line of sheeting on one side should not come to the plate, but a space of an inch or two be left, over which wire mesh can be tacked to keep out mice and rats and through which a circulation of air can pass from between the studs. The draft from blow can be secured by boring holes in outside lining with a good sizer auger, just above sills and wire mesh also tacked over this to keep out the vermin. Ventilation is necessary between the studs to prevent decay of the woodwork, which would gather moisture but for a circulation of air.

The lining between the sheeting, as already stated, should be tarred paper, of high grade, and acid and water proof. If one desires to go to the added expense, light weight galvanized iron may be used as lining. This will strengthen the silo as paper will not, and has more durability.

The doors should be in line over each other between the double sets of studs already referred to, and about two and a half feet apart. The layers of sheeting should be cut out between the studs, to make openings the width between the double studs and 30 inches high or more. Each door may be made of tongue and grooved flooring, nailed and screwed to another layer of the same stuff cross laid to it, with heavy tarred paper between. This door should be placed against the jambs formed by the two inside studs, and held in place by lag screws. The door should be placed flush with the inside lining, with its vertical boards inside. A gasket of rubberoid roofing can with advantage be placed between door and jamb, and when the silo is to be filled, a layer of

roofing paper well lapped over the entire door will help preserve the silage at this point. Mr. H. E. VanNorman of this Station in Fig. 3 suggests another door construction.

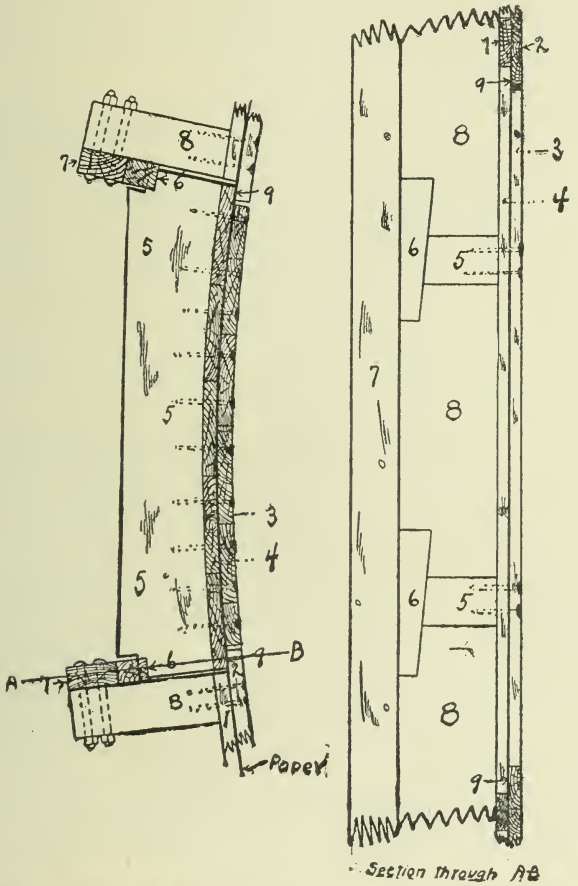

Fig. 3. Directions for Constructing Door in Wisconsin Silo.
By H. E. VanNorman.

1 and 2 are the two thicknesses of sheeting put on horizontally which make up the walls of the silo.

3 and 4 are the pieces jointly of the same thickness as the silo wall, which constitute the door and that are nailed to the 2x4 cleats.

No 5. vertically, put on with paper between and breaking joints.

Nos. 8, 8 are 2x6 used instead of the 2x4 studs which come each side of the doors.

No. 7 is a cleat 1:2—20 inches long nailed or bolted to the 2x6 opposite the doorway.

Nos. 5, 5 are 2x4's cut on one side to the curve of the silo wall and notched at opposite sides to make room for wedge.

No. 6 which is driven in between the cleat on the door and the strip on the studding to hold the door in place.

On each side of the row of openings use 2x6 studs in places of 2x4. When first sheeting is put on make opening the desired size and flush with studs. Make opening in inner sheeting one inch smaller on all four sides, thus making a one inch flange against corresponding flanges in which the door will fit, bringing the inside face of the door flush with the inside wall. The door is thus held in place by wedges driven in between the 2x4 cleats, 5, 5, on the door and the strips 7, 7, nailed or bolted to the studs.

Strips for a ladder to reach the upper doors may be nailed on the studs 8, 8, which will prevent studs from spreading.

This door may be removed from the outside by loosening the wedges without disturbing the silage against it.

The roof may be made of any kind desired, but the conical form, as shown on the first page is simple and attractive. Often the silo may be placed next to the barn, and a lean-to roof from the barn carried over the silo; this is cheap, yet serviceable.

The floor, if artificially made, should be of cement, being grouted about three inches, with a smooth layer of cement or concrete on the surface. A well cemented floor has a great advantage in keeping out the rats, and to a certain extent air. The side wall should be plastered over with cement, and connect with the floor to make an air tight joint. Only the best Portland cement is to be recommended for the floor and sides of this silo.

The Modified Wisconsin Silo.

Cheap silo construction in a general way is not to be commended, but the round silo may be built after the Wisconsin idea in a manner that will give very satisfactory service and yet at considerably reduced cost over the method described.

In 1901 this Station erected a silo of about 65 tons capacity,

which may be termed a modified form of the Wisconsin silo. This was 12 feet inside diameter, 28 feet high, using 16 and 12 foot studs end to end, and the studs were set on a circular foundation of two layers of brick laid in mortar. The silo was placed on the general level of the ground, and no special flooring was pro-

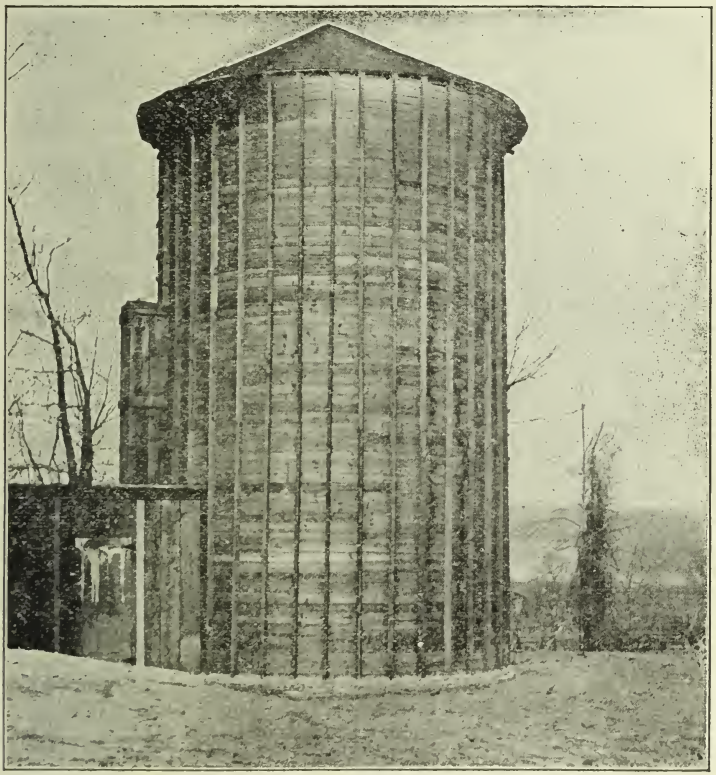

Fig. 4 Modified Wisconsin silo of E. W. Gove.

vided. The inside was sheeted about as directed in the preceding description, although the studs were 17 inches apart. No siding was placed on the outside of studs and no roof was provided. The total cost of this silo in round figures was $60.00, not including the cost of labor, which was supplied by two of the regular farm

laborers of the Station. The lumber involved in the construction cost $56.58. This silo appears strong and efficient in character.

Fig. 4 represents a silo of this same type, constructed by Mr. E. W. Gove on a farm near LaFayette under the direction of this Station. This silo is first class in every respect, so far as constructed. The studs are 18 inches apart, and for about half way up there are three layers of sheeting against the studs with tarred paper between. The upper half of the studs has but two layers of sheeting. The sheeting was made by taking 2x6 inch white pine planks and sawing to make four boards. This silo rests on a stone wall 18 inches deep and 16 inches wide. The silo is 30 feet high, and is 18 feet, 4 inches inside diameter, and holds about 150 tons. An inexpensive but durable roof was placed over it. The cost of this structure, as given to the writer, is as follows. As the work was all done by the regular farm help at odd hours, the item of labor is given as an estimated cost: Studding, $13.03; sheeting, $63.00; 5 rolls paper, $6.25; nails, $2.40; cement for wall, $2.40; labor, $20.00; total $107.08. The owner of this silo is so pleased with the service this one has rendered since its construction, that he now plans to build another like it this summer of 1902. This silo as is indicated by the illustration, is connected by a covered passage and chute with the feeding floor of the cattle barn.

The construction of this type of silo calls for as much care in putting on sheeting, making doors and keeping out air at these places and at the foundations, as is required with the more expensive form first described. The need for outer siding will depended in a measure on circumstances. Mr. Gove has had no trouble with his silage freezing this winter, while the silage at this Station froze in for a distance of a foot or more. Silage, however, is usually warm, although that in our silo the past winter, for almost the first time in the experience of this Station was cold, so that no heat was at hand to practically resist freezing. In northern Indiana the siding would naturally be more necessary than in the southern half of the state, but generally speaking, in the writer's opinion siding is not necessary, although it does materially add to the attractiveness of the silo.

The Stave or Tank Silo.

The stave silo represents a type that has become very popular during the past few years. This is of more recent adoption than the Wisconsin form. Stave silos are now extensively in use in various parts of the United States and Canada, and find many advocates.

In 1898 this Station erected a stave silo. This was 12 feet inside diameter, and 28 feet high, 16 and 12 foot staves being used to get the necessary height. This silo did not extend below ground, and the foundation which was laid out as directed for the Wisconsin round type, was about two feet deep.

In the construction of this silo white pine staves were used, dressed on four sides and with each edge bevelled 1-16 inch. The staves alternated in length, so that 16 and 12 foot lengths came side by side. The butting ends were held together by a strip of galvanized iron sheeting 2x5 inches, which was placed in a notch for the purpose sawed in the ends of the butting staves. Ten hoops of five-eighths inch round iron, with three-fourths inch ends threaded eight inches were used, the ends being welded on the rods. These were in two parts to facilitate tightening. As a support for the hoops at two points on opposite sides of the silo, taking the place of staves, and thus forming a part of the circle with the staves, was placed a 4x6 piece. Through the projecting four inches of this 4x6 at proper intervals were bored holes through which ends of the hoops were passed. The hoops were bent to the curve of the silo, by placing the rod on a curved piece of oak, following the curve of foundation, and bending to a line of curve by striking with the back of a heavy maul.

The erection of the stave silo will depend somewhat on local conditions, whether in a barn, quite near it on the outside, as at this Station, or some distance away, say 25 feet or more.

The following is the method by which this silo was erected above the foundation, and the doors provided for.

We first placed the two 12 foot 4x6 pieces in position, toe-nailing lightly the end resting on the wooden sill on the wall and bracing the upper end with a board nailed to a stake in the

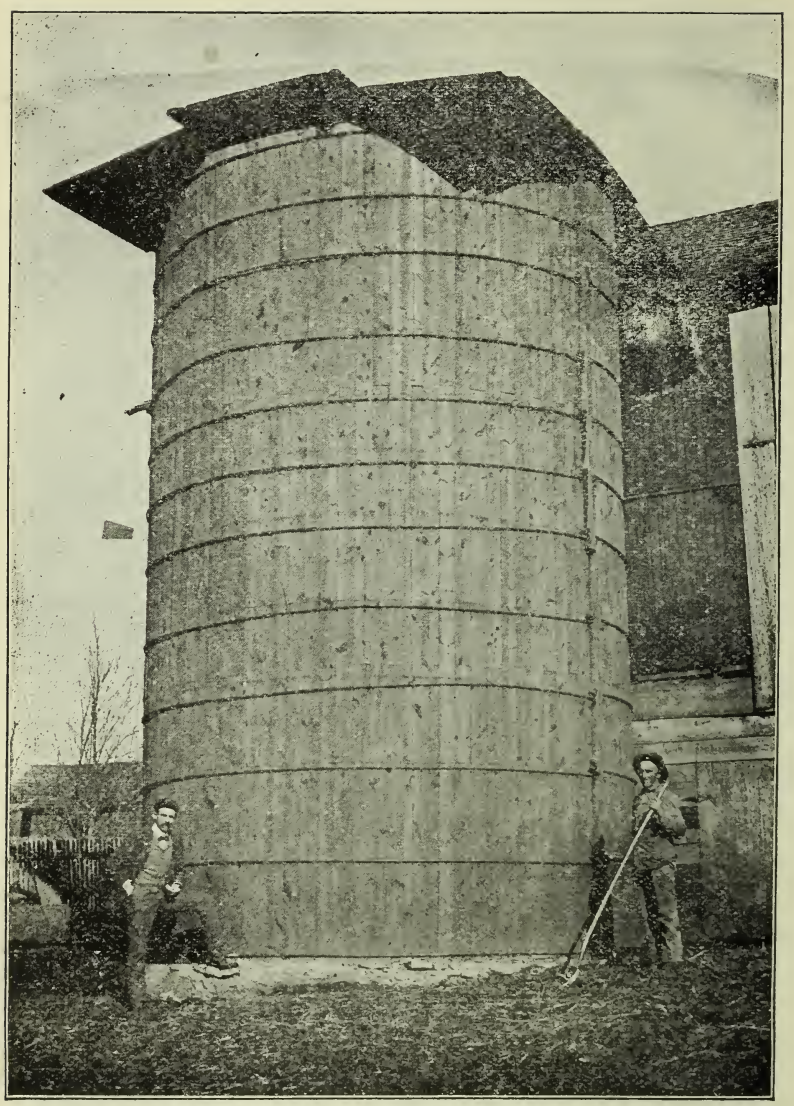

Fig 5. Stave silo of William Thorne.

ground. Hoops were then put in place, being supported by the 4x6 pieces, and by a stave placed half way between them, which was held to the hoops by a staple. The holes in the 4x6 varied in distance apart, according to point in silo depth. The bottom one was six inches from foundation, and the next six were two and one-half feet apart, with the two upper spaces under the top hoop, three feet apart, the top hoop being six inches from the top. The staves were then placed in position on the lower half of silo, 16 feet length joining the 4x6 pieces, and alternating all around with a 12 foot length. One half of the lower part was first put together and the hoops tightened, after which the opposite side was completed. Each stave was held in place by a wire nail driven in over the hoop and bent over as a hook. A good wire staple, however, is better. Before putting up the second tier of staves make a scaffolding on which to work, as directed in the construction of the Wisconsin silo on page 87. The 16 feet 4x6 pieces were then placed on end against the silo with the upper end resting between the same staves as the 12 feet length 4x6's A hoop was put in next to the top hole, then two men at each timber raised them, hoop and all up to their places. A brace with one large nail at each end, allowed the pieces to be raised without tipping over. The bottom hoop for the top half was then put in place but not tightened. The staves were then put up as in the first half; a ladder being leaned against the hoop, upon which a man worked at the top line of the silo. A a matter of convenience the strip of iron was placed in the base of the upper stave, and then dropped to the top of the lower stave and fitted in place.

In putting in the upper staves, the hoops nearest to the points where the staves join should be fairly loose, otherwise the upper staves cannot be readily crowded in place.

After the staves were in place, and the four hoops were drawn tight enough to hold securely, the remaining hoops were put on. One man stayed on the inside to drive back any stave which was too far in, while another tightened up the hoops.

Four doors were cut by sawing four staves at an angle of 45 degrees, the long side of the door being inside the silo. In

constructing the silo, when the place was reached where the row of doors should come, one stave was sawed nearly through in the right place for each door, and then the work of putting in staves continued. A narrow board was tacked on to prevent breaking this stave in handling. When ready to saw out the doors, this board may be removed, and as many staves cut as desired, for width of door.

Late in the season after the silo was filled, a roof was put on which is rather unique in itself. This consists of three parts. First two 2x6 pieces were laid on edge across the top and center of silo, extending north and south, and about two and one half feet apart, the north end projecting about eight inches, the south two feet beyond the staves. These were nailed to the staves. The reason for the two foot of projection is to hold the end of the carrier while filling. Next, two more 2x6's were placed on edge on top of the silo, one on each side and outside of the previous 2x6's, the ends projecting eight inches beyond the staves. To these two pieces were butted and spiked 2x4 pieces, which served as rafters, extending with a slight slope from the upper edge of 2x6 to the top of staves and equally distributed over the section of silo covered, the spaces between being about two and a half feet apart. Where each 2x4 rested on a stave, a notch about one inch deep was cut. These two frames of one 2x6 and four 2x4's were then covered with ordinary roof boarding, and each 2x6 hinged to the nailed piece along side of it and hooked to the circumference of silo on inside, a board cover was then laid over the central space, the boards being nailed to 2x2 pieces which dropped down on each side to the outside 2x6 like a trap door arrangement. The section was also hooked to the central 2x6's. A tinner then covered each section with tin roofing, which was afterwards painted and the work was done. This roof which is almost flat, can be easily removed at any time ,is of the most convenient type when filling, and is a safe place to work on.

This stave silo without a cement floor, cost as follows, which represents a greater sum than would be necessary to spend in many localities.

COST OF STAVE SILO.

Lime in cement in foundation	$ 5 00
Mason labor	3 60
Staves	70 70
Four 4x6's for hoop supports	5 20
Ten hoops	10 00
Staples and nails	30
Roof (lumber $5.00, tin $6.00)	11 00
Labor, two men for four days	10 00
	$115 89

The writer would call attention to the several features in stave silo construction that are worthy serious consideration, and if thought best, adoption.

Woven wire fencing may be used as bands to hold the staves together, in place of iron hoops. This fencing of the narrowest width and of any good standard woven pattern, should be cut so as to give the necessary length to go about the silo, with each end securely wound and fastened about 4x4 pieces the length of the width of the fencing. Holes should be bored through the 4x4, suitable for half-inch or larger bolts. When this fencing is wound about the silo, the sides of the 4x4's should be about six inches or more apart. The bolts are then passed through the two pieces of wood with washers on each side, and nuts placed thereon, and the blocks of wood drawn toward each other and the staves tightened up. This fencing wire can easily be adjusted at any time. At Cornell University Experiment Station the writer examined a silo constructed on this plan, and it seemed very well put together, simple and inexpensive.

In reference to method of tightening, King in discussing hoop for the stave silo, states that five-eighths iron rods in about 16 foot lengths form the best hoops.* He recommends long threads joined with iron lugs and nuts. "The iron lugs should always be used in preference to the 2x4's

*Physics of Agriculture, 1901, p. 422.

or 4x4's because they are better in every way." In visiting over 100 silos in 1891, he found that the heavy timber held dampness and caused rotting in three or four years, which will not be the case where iron lugs are used.

When the door of the stave silo is put in ,just at filling time, if the bevel of the door is plastered with a thick coat of puddled clay, and the door forced against it, air will be excluded more satisfactorily than where the clay is not used. A layer of tarred paper between door joints and silage is also recommended There is more or less swelling and contracting on the part of stave silo that must be carefully watched. In summer the staves shrink in the empty silo, and the hoops must be kept tightened, or staves may fall in. After the silo is filled, the staves swell and then the hoops need loosening to provide for this expansion. To assist in keeping the staves in place it will be well to have a shoulder in the foundation wall jut into the silo about two inches, with a similar shoulder on the outside. This is really equivalent to dropping the staves into a loose grove where there will be room for adjustment for shrinkage and swelling.

Staves used in silo construction are prepared in various ways. Some are simply rough sawed, but with the sides true in width. Others have the edges beveled slightly, as is usual in tank construction, while others use tongue and grooved staves, made with great care. The writer has seen silos with staves prepared in these different ways, and has seen superior silage in the roughest construction. Yet unquestionably too great care cannot be used in selecting material and in having each piece uniformly and well made. For this reason tongue and grooved material will be as a rule most satisfactory, although not in itself essential in every case to sucessful silage making.

Objection to Stave Silos. Considerable criticism has been made against the stave silo, notwithstanding, its extensive use. King calls attention to the objection to the shrinking and swelling process of the staves,* and the movement on the sills, by which

*Physics of Agriculture, 1901, p. 420.

air obtains access frequently to the silage and says: "There is no reason to hope that good silage with small losses in dry matter can be made in the stave silos which are not carefully constructed of good lumber, with the staves both bevelled, and tongued and grooved. It is really more difficult to make a stave silo air tight than it is a tank water tight, and we have found by careful tests that the unavoidable losses in a new stave silo next to the walls were as high as 23 to 28 per cent."

Numerous instances have occurred with stave silos located out of doors being moved on the foundations, or partly or entirely blown over. One very extensive farm in this State erected several stave silos, 25 feet each in diameter. They were made of the best material and of superior workmanship, but it was finally found absolutely necessary to line them with a layer of smooth, horizontal sheeting to keep them from collapsing when empty, as they would repeatedly buckle owing to the pressure of wind against the slight outward curves of the sides. These silos were placed on good foundations and were stayed by guy wires, but the diameter was too great for the type of silo. Consequently, stave silos of great diameter are not to be recommended. Probably 15 feet is a maximum diameter, two small deep ones, being more desirable than one large one.

In the judgment of the writer, the modified Wisconsin silo is preferable to the stave form. The expense is less, the construction is easier, more rigid and durable, there is no cost for hoops or bands, and the silo does not require frequent adjustment to keep in satisfactory condition. Probably no form of modern wood silo will give more satisfaction than the one first described in this bulletin, with the modified form the next best thing.

The Brick or Stone Silo.

The early silos made in this country and France were usually made of brick or stone, with the walls covered with cement plaster. The desire for something cheaper turned Americans into the con-

struction of the wooden one, until the silo made of wood became the rule and not the exception.

The brick or stone silo, however, is undoubtedly the most permanent of construction and should give satisfactory preservation of silage. If one has the money to spart, and stone or brick are conveniently at hand, then such a silo is to be recommended.

In constructing a brick silo, it will be well to guard the following points. Make the foundation of stone if practicable, and let the first course of brick come flush on the inside with the stone work. Bed a five-eighths inch iron hoop in the stone work in the upper part before laying the brick, in order to keep the pressure of brick from spreading the wall before the mortar becomes set and hard. Make a two inch air space in the walls up to within one third of the top. This will make a 14 inch wall of three courses of brick. If however, the silo is to be over 24 feet inside diameter, then a four brick wall is really necessary one-third the way up, then the next third of three bricks and the last third of two bricks. The air space should be in the outer part of the wall. Iron tie rods should also be laid around in the wall between the doors, as recommended in the stone work. It is also important that the brick shall be wet when laid; otherwise the mortar in which they are laid will be dried out too rapidly. The walls should be plastered over very smoothly with a coat of rich cement, one-fourth to one-half inch thick, and then every two or three years this should be well whitewashed with thin cement to keep the wall protected from the effects of the acid in the silage. King recommends that the floor jambs be made of 3x6's or 3x8's, rabbetted two inches deep to receive the door on the inside. The center of the jambs outside should be grooved and a tongue inserted projecting three-fourths of an inch outward to set back into the mortar and thus secure a thoroughly air-tight joint between wall and jamb. The doors may be made of two layers of matched flooring with tarred paper between, and lag screw bolted to the jamb so as to give a perfectly smooth face next to the silage.

The stone silo should have a wall about two feet thick below the surface of the ground, and this may be laid in the cheaper grades of cement. Above the surface a good grade of Portland cement should be used. A thickness of wall of 18 inches at the surface of the ground is desirable but this may be gradually reduced to 12 inches at the top, keeping the inner surface of the silo perpendicular. It is important to have five-eighths inch iron rods, with angles on the ends, laid in the wall at intervals between each door, to keep the wall from cracking or spreading before the mortar or cement is thoroughly set. These rods may be of several lengths, laid to the curve of the wall, and the angled ends should lap by each other for three or four inches.

Mr. Samuel Smith of Cass Co., in 1901 constructed a round stone silo 30 feet deep and 14 feet inside diameter. The stone is 12 feet below the ground on a hillside, and 18 feet above, and is laid in Portland cement. The stone is pointed on the outside and is plastered on the inside with cement. He states that No. 1 quarry stone was used and "any stones large enough to reach both sides of the silo wall, were broken so that the weather would not have a direct conductor inside and I never have had one bit of silage frozen." He used 4x4 pieces, four feet long, set into the wall at top and projecting five inches above, to which the roof was anchored.. A skeleton frame of 2x4's covered with shingled sheeting forms the roof.

It will be well to place silos below the surface a distance. This should not be deep enough on level land however, to require great exertion to get out the silage. Under such circumstances, four feet is deep enough.

Cement or Grout Silos.

During the past few years the use of cement silos has been adopted in Canada, especially in Huron and Perth countries. Valuable information on this subject has been contributed to the *Farmers' Advocate*, of London Ontario, Canada, by users of cement silos, from which the following notes are abstracted.

The foundation should be sunk in the ground some distance, and the wall rest on a hard bottom. One person states that he dug a trench two feet deep to hard bottom, and then filled it with cement and large stones, having a wall 18 inches wide and two feet high. The walls are erected above ground by the aid of "cribs."

"We have a double set of cribs. Each crib is 18 inches deep, and in four sections, the inside crib hinged in three places and tightened at the fourth with a clamp. The outside one is bolted together, and two one inch washers taken off every time you raise the crib, so as to get the right taper on the outside of the wall. There is a rim around the top side of each crib, one fitted into the other, so that they cannot get out of shape. We stand eight poles around the outside of the silo, and tie poles across these, and then lay planks across the corners, and that makes a good scaffold, on which you can wheel the cement around in a wheelbarrow and shovel it into the wall. We use two wheelbarrows, one getting filled while we empty the other. We draw all the cement up with a horse and swing pole.

In mixing cement and gravel, we use from one to nine to one to twelve, according to the quality of gravel."

For plastering the inside the best quality of clean gritty sand and Portland cement is necessary, one part cement and two parts sand which has been well sifted.

The walls are usually thicker at the bottom than at the top. A foot wall of 18 inches and top of nine inches will no doubt prove satisfactory. While stay rods are not placed in all cement silos, they prevent the cracking of the walls during the process of drying. It is important that a silo of this type be built early in the summer and the walls kept frequently sprinkled so as to not permit them to dry too rapidly. There should be several weeks for the wall to set in.

The cost of such a silo as this varies as might be expected. One man gives the total cost of a silo 28 feet high and 11¾ feet in diameter inside at $110.90, which includes labor and board.

The cost given by another for a silo of about this same size and capacity was $110.00. Still another gives the cost of a silo 30 feet high with inside diameter of 14 feet at $162.50, including $15.00 for a roof. These silos quite generally give satisfaction.

Capacity of a Round Silo

The following table is adapted from bulletin 59 of the Wisconsin Station, by King, using round figures mainly, instead of decimals.

The Approximate Capacity in tons of Round Silos for well matured Corn Silage.

Depth of Silo in feet	INSIDE DIAMETER OF SILO, IN FEET.											
	15	16	17	18	19	20	21	22	23	24	25	26
20	58¾	67	75½	84¾	94½	104½	115¼	126½	138¼	150½	163½	176¾
21	63	71½	80¾	90½	101	111¾	123¼	135¼	148	161	174¾	189
22	67¼	76½	86½	96¾	108	119½	131¾	144¾	158	172¼	186¾	202
23	71¾	81½	92	103¼	115	127½	140½	154¼	168¾	183½	199¼	215½
24	76	86½	97¾	109½	122	135¼	149¼	163¾	179	195	211½	228¾
25	80½	89¾	103½	116	129¼	143¼	158	173½	189½	206¼	224	242¼
26	85½	97¼	109¾	123	137	152	167½	183¾	201	218¾	237½	256¾
27	90¼	102½	115¾	129¾	144¾	100¼	176¾	194	212	230¾	250½	271
28	95	108	122	136¾	152½	169	186¼	204¼	223¼	243¼	264	285½
29	100	113¾	128¼	144	160¼	177½	195¾	215	235	255¾	277½	300¼
30	105	119½	134¾	151	168½	186½	205¾	225¾	246¾	268¾	291½	315¼
31	110	125	141	158	176¼	195¼	215¾	236¼	258¼	281¾	305	330
32	115	136	147¾	165¾	184½	204½	225½	247½	270½	294½	319½	345¾

This table should be of considerable service to persons contemplating building. One may readily ascertain his own silo needs, by figuring on the amount his stock will consume per day during the non-pasturing or soiling season, or say 180 days. One mature cow will consume to advantage from 25 to 50 pounds per day, depending on size and conditions. A beef animal should not be fed quite so heavily as a dairy cow, and 50 pounds is an ample feed for a heavy milker, for all cattle should also be fed hay as well as silage.

Should a Silo Have a Roof?

Should a silo have a roof is an important question. At the present time many consider the roof quite indispensable, but there are numerous silos to-day located outside the barn, without a roof over them. While a roof may perhaps not be considered a necessity, it is a convenience, and has its advantages. In regions of considerable snow and rain, silage free from snow and uniform in its moisture is preferable to that which is receiving large washings of water or is more or less covered with snow at frequent intervals. A silo, however, without a roof is filled to its top more conveniently than where the roof is on, and occasion will also happen when the rain water will be a desirable addition to the silage. The roof however, during the warmer months of the year, if silage be used, should protect the silage from drying out too rapidly and will also keep the walls of a wooden structure in better shape than when exposed to sunshine to such a degree as to promote rapid shrinkage or drying out.

Estimating Material and Cost of Silos.

The cost of material for constructing a silo varies greatly according to location. Timber is cheaper in northern or southern Indiana than in Central Indiana or the prairie region. Consequently no figures of cost for construction will be given in detail, for persons to base their estimates on. Instead, bills of material are herewith given, with spaces in which one may write the cost of the same as obtained in his neighborhood by which he may approximate the cost of a silo of moderate size. These estimates are made for silos built in the open on level land. On hillsides deeper walls may be made to advantage and where the silo is located within a building, no roof will be needed. Consequently various factors may alter the application of these estimates, which are only offered as suggestive, with the hope they may prove helpful.

ESTIMATE OF MATERIAL FOR WISCONSIN IMPROVED SILO.

Size 30 feet deep, 14 feet diameter. Capacity 90 tons.

Cost

Brick—3375 for foundation, 1 foot thick, 3 feet deep.....
Studs—50 pieces 2x4—16ft. long.....
Studs—50 pieces 2x4—14 ft long.....
Flooring for doors—32 ft 4 matched.....
Sheeting—3,000 ft. half inch resawed from 2x6—16 ft. plank sawed three times, dressed one side to uniform thickness for inside lining of two layers.....
Lining—1,500 feet of same for outside.....
Tar building paper—200 yards water and acid proof.....
Nails—200 lbs. 8 penny.....
Spikes—20 lbs. .....
Rafters—22 12x4—10 ft. long. For usual ridge roof.....
Sheeting for roof—350 feet of 16 ft. boards.....
Shingles—3,000.....
Shingle nails—12 lbs .....
Dormer window for filling through.....
Paint—7 gallons providing two coats.....
Cement—2 bbls. cementing bottom.....

Total Cost.....

ESTIMATE OF MATERIAL FOR MODIFIED WISCONSIN SILO.

Same capacity as preceding.

Cost

Brick—350 for foundation, 8 in. wide, 5 in. thick.....
Studs—50 pieces 2x4, 16ft long.....
Studs—50 pieces 2x4, 14ft long.....
Sheeting—3,000 ft. half-inch, resawed from 2x6, 16ft plank sawed three times, dressed to uniform thickness for inside lining of two layers.....
Tar Building Paper—200 yards water and acid proof.....
Nails—150 lbs. 8 penny.....
Spikes—12 lbs. .....

Total Cost.....

No outer siding, roof or floor is figured on or provided for in this construction.

ESTIMATE OF MATERIAL FOR STAVE SILO.

Size 12x28 feet. Capacity 60 tons.

Cost

Brick—1,800 for foundation, 1ft thick 2ft deep.....
Staves—77, 2x6, 16ft. dressed 4 sides.....

Staves—77, 2x6, 12ft. dressed 4 sides.....
Rods—10, 19½ ft. long of ½ inch iron, with 5-8 threaded ends and nuts.....
Staples—2 gross ½x2 inch.....
Iron Tighteners—20 holding ends of hoops.....
Rafters—2, 2x6 pieces, 14 ft. long for roof center.....
Rafters—2, 2x6 pieces, 13ft. long for roof, next center.....
Side rafters—48 ft. 2x4 pieces.....
Roof sheeting—170 ft. common.....
Tin sheeting—196 ft.....
Cement for floor, 2bbls.....
Total Cost.....

Location of Silos in Indiana.

Silos are found most abundant in the more distinctively dairy sections of the State, and especially about the larger cities and in the counties where creameries are common. South of Indianapolis but comparatively few silos occur. Lake, Porter, Allen, Marion, Henry, Wayne and Union counties probably represent the best silo districts in Indiana. Persons wishing to inspect silos before building, will find good specimens of round ones at the following addresses, which represent a wide distribution over the State. You should enclose a stamp for reply if you write any of the following addresses:

Wisconsin round form.....W. L. Thompson, Indianapolis, Marion Co.
Stave.....J. J. W. Billingsley, Indianapolis, Marion Co.
Wisconsin modified.....E. W. Gove, LaFayette, Tippecanoe Co.
Wisconsin modified and stave.....
.....Experiment Station, LaFayette, Tippecanoe Co.
Stave.....C. T. Mattingly, Plymouth, Marshall Co.
Stave.....J. M. Hack, Crown Point, Lake Co.
Stone.....Samuel Smith, Logansport, Cass Co.
Stave.....T. E. Ellison, Fort Wayne, Allen Co.
Wisconsin.....School Feeble Minded Youth, Fort Wayne, Allen Co.
Stave.....T. C. Burnside, Liberty, Union Co.
Stave.....Call Husselman, Auburn, DeKalb Co.
Stave, sheeted.....American Farm Co., Morocco, Newton Co.
Round, plastered...E. F. Hanning, Evansville, R. R. 3, Vanderburg Co.
Stave.....J. W. Griffiths, Dunreith, Henry Co.
Stave.....William Thorne, Huntington, Henry Co.

The word Silage is considered a preferable word to Ensilage.

PURDUE UNIVERSITY.

Indiana Agricultural Experiment Station.

C. S. PLUMB, Director.

LaFayette, Ind. Bulletin No. 92, Vol. XI, April, 1902.

Fertilizer Tests on Tomatoes.

BY H. A. HUSTON.

At many points in central Indiana are large establishments for canning vegetables. One of the most important products of these factories is canned tomatoes. There are six states in which large quantities of tomatoes are canned and among these, Indiana stands second. For the past five years, 1897 to 1901, Maryland packed an average of 1,840,000 cases; Indiana, 697,200; New Jersey, 685,400; California, 473,200; Delaware, 360,000 and Ohio, 190,200. A case contains 24 cans holding three pounds each. The amount packed each year varies greatly; thus the cases packed in each of the six states for five years were as follows:

STATE.	1897	1898	1899	1900	1901
Maryland	1382000	1919000	2840000	1368000	1691000
Indiana	588000	1020000	828000	630000	420000
New Jersey	520000	810000	871000	815000	411000
California	306000	300000	508000	556000	696000
Delaware	209000	450000	547000	381000	213000
Ohio	153000	211000	249000	234000	104000

These statistics are furnished through the courtesy of Mr. W. A. Sampson, Secretary of the Indiana Canners' Association. One bushel of tomatoes will make 14 cans of three pounds each, or one case of tomatoes represents 1.715 bushel of tomatoes, so that Indiana produces on the average 1,200,000 bushels of tomatoes each year for which farmers receive about $240,000.

The above table is published mainly for the purpose of calling attention to the very great variation in the crop from

year to year. With our grain and corn crops, the amount of rainfall during the growing season is the main factor in determining the amount of the crop. The rainfall is of the utmost importance in determining the yield of tomatoes, but in addition to this a late spring or an early frost in the autumn may diminish the crop fully one half. The crop is also subject to fungus diseases which are more apt to result in serious damage when several successive tomato crops are grown on the same land.

Most of the work published on the subject of tomato raising relates to the early market crop. For this reason many of the suggestions offered are not applicable to the crop for canneries.

In raising tomatoes for canneries, the grower, first of all seeks a large yield. Early maturity is of less importance since he contracts to sell the whole crop at a fixed price. This fact must be taken into consideration in selecting the variety of tomato to be raised, the soil, and the kind of fertilization. In Indiana the usual practice is for the canneries to furnish the plants so that the grower has only to deal with the selection of the soil, the fertilization, the cultivation, and harvesting of the crop.

The Soil.

For tomatoes for canneries a much heavier soil and one of higher natural fertility may be used than is recommended for tomatoes for the early market. In Indiana the growing season in the field is in an average year from May 15 to September 15. In very favorable seasons the growing season may extend a month longer. Hence, there is ample time for the plant to utilize the food ingredients present in the soil, provided the water supply is uniform enough throughout the season. During many seasons the rainfall is low in July and August, and the growth of the plants is checked. This may be provided against in some measure by deep plowing of the land. This is best done in the fall; if fall plowing is impracticable the land should be plowed as early as possible in the spring, so as to store as much as possible of the water of the spring rains. After a thorough preparation of the land for setting out the plants, a thin layer of fine earth main-

tained on the surface by shallow cultivation will render great service in saving the water supply. Lands which have had green crops turned under or to which applications of barnyard manure have been made will have their water holding capacity increased and will also retain the water better. Where barnyard manure is used on tomato land it is advisable to apply it in the fall and work it well into the soil at that time.

While it is rather more difficult to cultivate tomatoes on heavier lands it is the experience of catsup makers that on these lands a tomato of superior quality is produced in that the relative quantity of pulp in the tomato is increased. For heavy yield it is essential that strong land or heavy fertilization be used. The crop for the cannery is one for which a relatively low price is obtained and hence the cost of fertilization has to be carefully considered. While it is true that on many of the soils of central Indiana a remunerative crop may be produced without fertilization, it is also true that on nearly all of these soils additional fertilization may be profitable.

The tomato plant is a gross feeder and requires an abundant supply of potash. Voorhees* estimates that 10 tons of fruit with the accompanying vines would contain 57 pounds of nitrogen, 16 pounds of phosphoric acid, and 94 pounds of potash. While the composition of the crop does not indicate the quantities of each fertilizer ingredient that can be most profitably used, it is useful when considered in connection with the known qualities of the soil.

There is no question that in Indiana soils that contain considerable clay, phosphoric acid is relatively low and that for crops like corn and vegetables the application of potash is also needed to produce the most profitable crops. These needs are greater in proportion to the number of years that the land has been under cultivation. The nitrogen supply is more variable, but on lands where a rotation with clover has been used, the nitrogen supply is

*Fertilizer, p. 233.

probably considerable higher than on the eastern lands devoted to the late tomato crop.

As a rule, the canneries in Indiana are located in sections of the state where very little fertilizer is used on any crop and where farmers have never given any attention to the subject of commercial manures.

The manufacturers of fertilizers for use in Indiana have not offered goods especially prepared for tomatoes because of a lack of demand and from a lack of knowledge of the requirements of our soils. During the past few years both growers and canners have occasionally asked for advice and assistance in regard to fertilizers to be used on tomatoes. As the fertilizers in our market were not of the composition found most useful for late tomatoes, in other sections it was deemed advisable to undertake some experimental work on the subject.

Fertilizer Experiments on Tomatoes.

In the spring of 1899, I met a large number of tomato growers at Franklin, Indiana and later arranged to conduct tests on four farms at Franklin and Greenwood. The formula used was based on that recommended by Voorhees for late tomatoes*, but instead of using bone tankage we used azotin and acid phosphate in proper amounts, since it was desirable to have plants to which no phosphoric acid was applied.

Voohees' formula calls for a fertilizer containing:

Nitrogen	4.7 per cent.
Prosphoric acid	7.2 per cent.
Potash	12.5 per cent.

It is the intention to have part of the nitrogen and phosphoric acid immediately available, and a part of each available during the maturing period. With this purpose in view the goods are made of

Nitrate of soda	400 pounds
Bone tankage	700 pounds
Acid phosphate	400 pounds
Muriate of potash	500 pounds

The bone tankage is a product often called butchers' tankage, and

*Voorhees; Fertilizers, p. 233.

contains about five per cent of nitrogen and 11 per cent of phosphoric acid. The other materials are all well known and readily obtained in the Indiana markets.

It is recommended to use 500 pounds of this mixture to the acre, and our experiments were based on this amount.

The materials for one ton of this mixture could be purchased at retail for about $32.00, making the cost per acre $8.00.

The system adopted in planning these tests was the usual one for field testing of soils. The plats were one twentieth of an acre each, and some extra plats were used for special purposes. The only farm on which the work was completed was that of Mr. Charles Keay of Franklin. Mr. Keay continued the work for two years and his reports are complete in every detail, and give evidence of most careful work. Mr. Keay's land originally had a good deal of beach timber on it; it is a moderately heavy clay loam in good mechanical condition, has been cleared 30 years, was never manured, and in a fair season will raise 24 bushels of wheat per acre or 50 bushels of corn.

At the rate of setting plants on this farm, there were 2240 tomato plants to the acre or 112 plants in each plat. The plats were arranged to consist of four rows of 28 plants each, and between each plat two rows were left to which no fertilizer was applied. The following applications were made to the plats:

Plat No. 1.....	No fertilizer.	
Plat No. 2.....	Muriate of potash.....	12½ lbs.
	Nitrate of soda.....	10 lbs.
	Azotin	6 lbs.
	Acid phosphate.....	10 lbs.
Plat No. 3.....	Muriate of potash.....	6¼ lbs.
	Nitrate of soda.....	5 lbs.
	Azotin	3 lbs.
	Acid phosphate.....	5 lbs.
Plat No. 4.....	Muriate of potash.....	12½ lbs.
	Acid prosphate.....	10 lbs.
Plat No. 5.....	No fertilizer.	
Plat No. 6.....	Muriate of potash.....	12½ lbs.
	Nitrate of soda.....	10 lbs.
	Azotin	6 lbs.

Plat No. 7.....	Nitrate of soda.....	10 lbs.
	Azotin	6 lbs.
	Acid phosphate.....	10 lbs.
Plat No. 8.....	Nitrate of soda.....	10 lbs.
Plat No. 9.....	Azotin	13 lbs.
Plat No. 10.....	No fertilizer.	
Plat No. 11.....	Barnyard manure in 1900 only.	

The fertilizers were prepared at the Station, and the quantity for each plant was put in a small paper sack. In 1899 the plants were set May 19, and in 1900 they were set May 18.

The fertilizer was well mixed with the soil about the plant at the time of setting. Plat 3 to which only one half the amount of fertilizer was added was included to get a little light on the question of the amount of fertilizer necessary. Plat 8, on which nitrate alone was used, was introduced because in the eastern states nitrate alone has often proved very profitable, and Plat 9 was introduced to compare organic nitrogen with nitrate.

Plat 11 was introduced in 1900 by Mr. Keay to observe the effect of barnyard manure. Part of the manure was applied to clover sod in the spring of 1899, and the land plowed in the spring of 1900, and top dressed with manure. Mr. Keay estimates that the manure was applied at the rate of 12 to 15 two horse loads (35 bushel wagon bed) per acre.

In tables 1 and 2 are Mr. Keay's records for each year. They are given in detail in order to show not only the total gain but also the gain at each picking, since it seldom happens that all the tomatoes are harvested before the vines are killed by the frost and it is a matter of much importance to learn if the fertilizer aids in increasing the relative amounts on the early pickings

The results on plats 2 and 3 in both seasons show the desirability of using a complete fertilizer on lands of this kind, and that it is desirable to use it in liberal amounts. The increased yield on plat 2 over that on plat 3 is much more than enough to pay for the increased cost of the fertilizer. The use of nitrogen alone was unprofitable either in the form of nitrate or in the form of organic nitrogen. It is probable that on lands of this type where

FERTILIZER EXPERIMENTS ON TOMATOES.

Records of Yields on Plats of One Twentieth of an Acre. Farm of Chas. Keay, Franklin, Ind.

TABLE I YIELDS IN 1899.

Plat No.	1	2	3	4	5	6	7	8	9	10
Date of Picking.	lbs oz	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs.	lbs oz.	lbs, oz	lbs. oz.
Aug. 18	10 4	43 8	37	38	16	18 4	33	8 8	16 4	13 12
Aug. 22	13 4	37	33	27	21	21	28	8 12	19	18
Aug. 25	9	15 12	11	11 8	13 4	6 8	20	5	13	10 8
Aug. 30	22	36	26	24	18	25	31	13	28	27
Sept. 4	34	85	81	70	46	59	59	46 4	39 12	51
Sept. 8	25	41 8	35	37	39	32	47	22	23	24
Sept. 13	18 8	52	39	41	30	52	34	35	34	29
Sept. 22	51 12	77 12	69	79	62 12	86	53	60	68 12	37 8
Sept. 27	112 4	213	151 12	171	115 4	176	130	134	158 4	129
Sept. 29	31	27	33	14	21	16	16	13 12	17	7
Total	327	628 8	515 12	512 8	382 4	491 12	451	346 4	417	346 12
Tons per acre.	3.27	6.28	5.15	5.12	3.82	4.91	4.51	3.46	4.17	3.46
Inc. tons acre.		2.76	1.63	1.60		1.39	0.98		0.65	

TABLE II. YIELDS IN 1900 ON KEAY FARM.

Plat No.	1	2	3	4	5	6	7	8	9	10	11
Date of Picking.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
Aug. 1	3	11	20	5		15	8	14	10	10	
Aug. 4		14	32	3 8	9	3 8	15 8	9	12		1 14
Aug. 6	6 8	22 8	20 12	16 4		8	22	15	14	10	12 4
Aug. 8	1 12	12	6	9 12			13				
Aug. 10	9	27 8	19 4	31	6 12	9 8	27	8 12	6 8	4 8	54 8
Aug. 14	29	72 8	40	58	15 12	18	72	18 8	12 12	10	77
Aug. 18		48 8	14	31 8		31	34				
Aug. 20	22 10	45 8	47	33 4	16 8	23	66 8	31	20 4	25	89 12
Aug. 24	41 8	113 8	110	89	42	61 8	111 12	49	57 8	41 8	90
Aug. 27	32 4	86	89	77 4	21 4	25 4	73 8	28 8	25	26 4	73 4
Aug. 31	15 2	41 8	26	38 12	13 6	37 12	31	17	15	14	100
Sept. 4	22	40	23 10	53	23 3	38 7	71 12	30	34 11	24 11	127
Sept. 10	41 13	39 9	18 4	53 12	41 5	102 12	95 12	61	50 12	43 4	253 2
Sept. 14	41 3	38 8	17	43 3	39 6	82 10	65 6	59 11	50 13	36 12	128 13
Sept. 19	26 5	18 12	14 6	26 3	33 6	34 11	44 8	43 8	53 6	31 11	41 12
Sept. 24	16 8	10 2	9 6	8 6	17	15 10	16 4	20 4	17 12	12 9	11 12
Oct. 1	17 5	14 10	15 2	11 8	14	19 9	8 14	12 8	10 14	10 8	7 14
Oct. 13	3 14	4 8	5 7	2 10	3 8	4	4 7	4 8	3 12	2 12	2 4
Total	329 12	660 9	527 11	591 14	287 15	508 10	781 3	386 9	361 4	284 11	1071 3
Tons per acre	3.29	6.60	5.27	5.91	2.87	5.08	7.81	3.86	3.61	2.84	10.71
Increase tons per acre		3.60	2.27	2.91		2.08	4.81	0.86	.61		7.71

clover is used in rotation, a fertilizer containing nitrogen three per cent, available phosphoric acid, seven per cent, and potash twelve per cent would be nearly as serviceable as one containing five per cent of nitrogen and the cost of fertilizer could be reduced about $5.00 per ton. If growth was not vigorous enough, 50 to 100 pounds of nitrate could be applied early in July. The remarkable result on plat 7 in 1900 is probably due to some peculiarity of the soil on this plat. At the time the plats were laid out, it was noticed that the appearance of a part of this plat was quite different from the rest of the land. The remarkable results of the use of manure on plat 11 are of much interest as indicating what may be accomplished on soils that have received no manure for 30 years.

Neither season was very favorable to tomato growing, and the yields are below the average.

Mr. Keay especially calls attention to the fact that on the fertilized plats there was not only a great increase of yield but that many more tomatoes ripened early in the season, a matter of much importance in years when early frost occurs. This early ripening did not occur on the manured plat.

The results of these experiments certainly indicate that there is a field for the profitable use of commercial fertilizers in tomato growing on lands such as were used. In 1899 the experiments were duplicated on the Station farm with the result that the use of fertilizers gave very little increase in yield*. The yields were large, 12 tons per acre. The Station farm is second bottom land and experiments in the past show that it does not respond to the use of fertilizers on vegetables.

The formula given for compounding the fertilizer uses muriate of potash. Some experiments on early tomatoes seem to indicate that the sulfate of potash gives tomatoes of better quality. If one wishes to secure better quality as well as an increased yield it would probably be better to specify potash derived from sulfate. All properly made tobacco fertilizers contain the sulfate and the material is readily obtained. The same quantity should be used as is given for muriate.

*13th annual report, p. 68.

PURDUE UNIVERSITY.

Indiana Agricultural Experiment Station.

C. S. PLUMB, Director.

LaFayette, Ind. Bulletin No. 93, Vol. XI, June, 1902.

The Influence of Condimental Stock Food in Fattening Swine,

BY C. S. PLUMB.

For years American stockmen have fed to a more or less extent what are generally regarded as conditional stock foods. The foods often contain considerable oil meal, some fenugreek, which gives it a pleasant ordor, ground ginger, gentian, etc. These foods are more especially used by owners of horses and cattle, and perhaps have been comparatively little used by pig feeders.

So far as I am aware, foods of this class have not been fed swine at our Experiment Stations, excepting in a very small way, and no definite information has been available as to the merits of such food fed swine.

To get some data on the subject, eight pigs were selected and the following experiment was begun on October 16, 1899, under the charge of Mr. H. E. VanNorman, assistant to the writer.

The animals used consisted of six Poland China sows, farrowed on June 22, 1899, and two Chester White sows farrowed on June 10, 1899. They were divided into two groups, so as to

bring three Poland Chinas and one Chester White in each group, as follows:

Nos. 257, 258 and 260 in Lot I, and Nos. 254, 256 and 259 in Lot II are Poland Chinas, and No. 265 in Lot I and No. 264 in Lot II are Chester Whites. On October 16 the four pigs in Lot I weighed 260 pounds or 65 pounds each, while those in Lot II weighed 257 pounds or 64 pounds each.

The pigs in each lot were fed a mixture of half shorts and half hominy feed, while those in Lot I were given in addition a small amount of American stock food in each ration. This character of feed was supplied during the term of the experiment which extended from October 16, 1899 to February 14, 1900, a term of 122 days.

The following table shows the amount and character of the food eaten by each lot of pigs during each weekly period:

TABLE I.

Total food fed per period, lbs. and ozs.

Periods, 7 days each		Lot I			Lot II	
		Shorts	Hominy feed	American Stock food	Shorts	Hominy feed
I	Oct 18-25	42¾ lb	42¾ lb	1lb 15 oz	42¾ lb	42¾ lb
II	Oct 25-Nov 1	51½ lb	51½ lb	2lb 14 oz	51½ lb	51½ lb
III	Nov 1-8	56 lb	56 lb	2lb 10 oz	56 lb	56 lb
IV	Nov 8-15	56 lb	56 lb	2lb 10 oz	56 lb	56 lb
V	Nov 15-22	63 lb	63 lb	2lb 10 oz	63 lb	63 lb
VI	Nov 22-29	70 lb	70 lb	2lb 10 oz	70 lb	70 lb
VII	Nov 29-Dec 6	83 lb	83 lb	2lb 10 oz	83 lb	83 lb
VIII	Dec 27-Jan 3	84 lb	84 lb	5lb 4 oz	84 lb	84 lb
IX	Dec 13-20	84 lb	84 lb	3lb 8 oz	84 lb	84 lb
X	Dec 20-27	84 lb	84 lb	3lb 8 oz	84 lb	84 lb
XI	Dec. 27-Jan 3	84 lb	84 lb	5lb 4 oz	84 lb	84 lb
XII	Jan 3-10	84 lb	84 lb	5lb 4 oz	84 lb	84 lb
XIII	Jan 10-17	84 lb	84 lb	5lb 4 0z	84 lb	84 lb
XIV	Jan 17-24	91 lb	91 lb	5lb 4 oz	91 lb	91 lb
XV	Jan 24-31	98 lb	98 lb	5lb 4 oz	98 lb	98 lb
XVI	Jan 31-Feb 7	68 lb	68 lb	5lb 4 oz	85 lb	85 lb
XVII	Feb 7-14	90 lb	90 lb	5lb 4 oz	90 lb	90 lb
120 da	Total	1273¼ lb	1273¼ lb	64lb 5 oz	1290¼ lb	1290¼ lb

During the experiment the pigs in each lot were weighed at the end of each weekly period, and a record was kept of the same. The general health of the animals was excellent, and there was no set-back to the experiment.

Table II gives the weights of each pig, which are as follows:

TABLE II.

Weights of pigs in pounds.

Date	Lot I — Fed American Stock Food.					Lot II — Fed no Stock Food.				
1899. 1900	No. 257	No. 258	No. 260	No. 265	Total Wt.	No. 254	No. 256	No. 259	No. 264	Total Wt.
Oct 18..	58.5	44.	67.	94.5	264.	52.	56.5	62.5	88.	260.
Oct 25..	69.	51.	75.5	108.	303.5	60.	65.	70.	98.	293.
Nov 1..	78.	57.5	86.	117.	338.5	72.	71.5	78.	107.5	329.
Nov. 8..	89.	65.	95.	128.	377.	82.5	82.	89.5	120.	374.
Nov. 15.	95.	71.	103.	137.	406.	87.	90.5	93.	123.	393.5
Nov. 22.	106.5	81.5	114.	150.5	452.5	100.	99.	100.5	134.	433.5
Nov. 29.	119.	91.	126.5	160.	496.5	113.5	112.5	116.	148.	490.
Dec. 6...	130.	105.5	138.	174.	547.5	128.	121.	129.5	163.	541.5
Dec 13..	140.5	113.5	147.	189.5	590.5	135.	129.	137.	170.	571.
Dec 20...	149.5	131.5	161.	202.5	644.5	147.5	146.5	147.5	184.5	626.
Dec 27..	164.	135.	175.	216.	690.	162.5	159.	159.5	191.	672.
Jan. 3...	169.	141.	184.	221.	715.	169.	166.	169.5	197.	701.5
Jan 10..	185.	154.	198.	234.	771.	181.	182.5	181.	205.	749.5
Jan 17..	194.	163.	205.	239.	801.	193.	194.	191.5	208.	786.5
Jan 24..	202.	175.	213.	256.	846.	206.	203.	204.	216.	829.
Jan 31..	219.	193.5	229.	271.	912.5	217.	215.	209.	235.	876.
Feb. 7..	217.	192.	227.	258.5	894.5	227.	225.	221.	235.	908.
Feb 14..	223.	202.	245.	276.	946.	241.	231.	235.	242.	949.
To'l gain	164.5	158.	178.	181.5	682.	188.	174.5	172.5	154.	689.

From the tables it is shown that the following gains were made:

	Lot. I Condimental Food.	Lot II. No Condimenial Food.
Total gain in 120 days	682.0 lbs	689.0 lbs.
Average gain per pig	170.5 lbs	172.2 lbs.
Average daily gain per pig	1.42lbs	1.43lbs.
Average daily gain per lot	5.68lbs	5.74lbs.

If we examine into the cost of production, taking seventy cents(.70 cts.) per hundred as the cost of the shorts and hominy feed which was the case at this time, and estimating five cents (.05 cts.) per pound as the price of the stock food, we obtain the following resuluts:

	Lot I.	Lot II.
Total pounds of gain	682	689.
Value of gain at 4½ cts per lb	$30.69	$31.00.
Total cost of food consumed	21.03	18.06.
Profit	$ 9.66	$13.94.
Cost of producing each pound of gain	3.0 cts	2.6 cts
Pounds of food required per lb of gain	3.84	3.71

The results of this experiment favor Lot II where no condimental food was used.

Another experiment in this same field was taken up by Mr. C. W. Ely, a 1902 graduate of the School of Agriculture of Purdue University, under the direction and supervision of the writer. Mr. Ely made a very complete report upon this experiment, from which the writer abstracts the following details:

Six grade Poland China barrows were used, and were divided into two lots of three each. On January 23, 1902, Lot I weighed 176½ lbs. and Lot II, 177½ lbs. For one week following this date each lot was fed the same food, consisting of equal parts corn meal and shorts. On January 30, when the experiment began, Lot I showed a gain of 14 lbs, and Lot II of 11½ lbs.

Beginning on January 30, in the afternoon Lot I was fed one tablespoonful of Rauh's Stock Food, in the grain ration which was the same for each lot as during the previous week, this being adopted as the permanent ration.

An analysis of this Stock Food given in the Twelfth Annual Report of this Experiment Station, shows that it contains 53.70

per cent protein, and that it contains a large amount of animal matter.

On March 6, Standard Stock Food was substituted for the Rauh's.

Table III gives the weekly weights of the individual pigs in each lot, and the total weights.

TABLE III.

Weights of pigs, in pounds.

1900. Date	Lot I				Lot II			
	No. 397	No 398	No. 399	Total	No. 400	No 401	No. 402	Total
Jan. 30	65	58½	66½	190	65½	66½	57	189
Feb. 6	72	66½	75	213½	72	71	63½	206½
Feb. 13	80	75	81	236	79	80	69	229
Feb. 20	92	82½	91	265½	89	88	78	255
Feb. 27	100	91	97	288	99	97	83	279
Mar. 6	110	99	112	321	109	107½	92	318½
Mar. 13	118	111	122½	351½	120	122	101	342
Mar. 20	124½	113½	130½	368½	131½	128½	106½	366½
Mar. 27	138	132	146	416	146	142½	118	406½
Apr. 3	150	142	154½	446½	154	148	121½	423½
Apr. 10	161½	161	164	486½	170	164	136	470
Apr. 17	171½	171½	178	521	178	178½	149	505½
Apr. 24	191	187	199	577	199	193	163	555
Gain	126	128½	132½	387	133½	126½	106	366
Av. wk. gain	10.5	10.7	11.04	22.25	11.13	10.54	8.83	30.5

The above figures show a gain of Lot I, fed condimental foods of 387 lbs., while Lot II showed a gain of 366 lbs., or 21 lbs in favor of Lot I.

These pigs were fed and ate the following amounts of food, as shown in Table IV.

TABLE IV.

Pounds and ozs. of food fed per week.

Date	Lot I		Lot II
	½ corn meal, ½ shorts and stock food		½ corn meal and ½ shorts
1902	Meal and shorts	Stock food	
Jan. 30-Feb. 6 ...	63 lbs. 12 ozs.	5¾ ozs.	61 lbs.
Feb. 6-Feb 13 ...	74 lbs. 0 ozs.	5¾ ozs.	70 lbs. 12 ozs.
Feb. 13-Feb. 20 ...	86 lbs. 6 ozs.	5¾ ozs.	82 lbs. 0 ozs.
Feb. 20-Feb. 27 ...	93 lbs. 0 ozs.	5¾ ozs.	89 lbs. 0 ozs.
Feb. 27-Mch. 6 ..	106 lbs. 12 ozs.	8 ozs.	103 lbs. 10 ozs.
Mch. 6*-Mch. 13...	107 lbs. 2 ozs.	5¾ ozs.	113 lbs. 12 ozs.
Mch. 13-Mch. 20 ..	113 lbs. 0 ozs.	8.4 ozs.	113 lbs. 6 ozs.
Mch 20-Mch 27 ..	126 lbs. 2 ozs.	8.4 ozs.	127 lbs. 0 ozs.
Mch. 27-Apr. 3 ...	130 lbs. 4 ozs.	9¾ ozs.	103 lbs. 10 ozs.
Apr. 3-Apr. 10 ..	141 lbs. 14 ozs.	11.2 ozs.	133 lbs. 6 ozs.
Apr. 10-Apr. 17 ..	143 lbs. 4 ozs.	11.8 ozs.	152 lbs. 0 ozs.
Apr. 17-Apr. 24 ..	169 lbs. 0 ozs.	14. ozs.	170 lbs. 4 ozs.
Total.....	1354 lbs. 8 ozs.	100¼ ozs.	1324 lbs. 12 ozs.

*Began use Standard stock food March 6.

During the first three or four weeks the pigs fed condimental food ate apparently with more relish than did Lot II, but this difference in appetite gradually disappeared. As Lot I ate slightly more than Lot II, perhaps this was due to the condimental food although it is more probable that it is due to the fact that Pig No. 402 of Lot II was a poorer individual than the other five pigs. The health of the pigs was fairly good all through the experiment.

A financial statement of this experiment appears as follows:

	Lot. I	Lot II
Gain in weight 387 lbs. at 6 cts per lb.....	$23.22	
Value of 677¼ lbs. corn meal at $1.35 cwt.....	9.14	
Value of 677¼ lbs. shorts at $1.00 cwt.....	6.77	
Value of 6½ lbs. condiment at 5 cts.....	.33	
Total value.....	$16.24	
Profit	6.98	
Gain in weight 366 lbs. at 6 cts. lb.....		$21.96
Value of 662⅜ lbs. corn meal at $1.35.....	$ 8.84	
Value of 662⅜ lbs. shorts at $1.00.....	6.62	
Total value.....	$15.46	$15.46
Profit		$ 6.50

This shows a profit in favor of the condimental food, of 48 cents.

These two different experiments, in results are very generally in harmony with experiments conducted by Lawes and Gilbert in England, on the influence of stock foods, and also with other experiments where similar studies were made.

In themselves, there is no special objections to stock foods. In fact there are brands made that are rich in nutriment, and have a high value as a food. The principle criticism that can be made is the excessive price generally charged for them, which is far beyond their value. No doubt, in many cases oil meal will give fully as satisfactory results as the stock food. The feeder should study this matter carefully, and if he will use a variety of food, including oil meal, and will ascertain the value of some of the more common tonics that may be given stock in the foods, he will secure no doubt equally good results at the least cost. He will in fact be able to make his own stock food, and thus save paying high prices for feed of an unknown character.

Purdue University

Agricultural Experiment Station

BULLETIN No. 94, Vol. 12
FEBRUARY, 1903

DISEASES OF SHEEP.

PUBLISHED BY THE STATION,
LAFAYETTE, IND.,
U. S. A.

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Diseases of Sheep.

General Treatise by R. A. Craig, D. V. M.
Laboratory Work by A. W. Bitting, D. V. M., M. D.

Sheep are subject to as great variety of diseases as most other farm animals. Some of the diseases are much more common than others, and this fact together with the great similarity in the behavior which the animal shows in most diseases, has led flock-masters to think that sheep are subject to few ailments. The similarity in behavior in the early stages makes it difficult to form a diagnosis without a thorough examination of the animal and surroundings.

In examining a sheep, the behavior, appearance, general condition and surroundings must all be taken under consideration. The history should be obtained from the attendant as frequently that is of importance in arriving at a diagnosis and in determining the line of treatment. In none of the domestic animals, can disease be more successfully combatted by prevention than in sheep. It is along this line of treatment that we must direct greatest attention as the animals are not good patients when once attacked.

The Symptoms inform us as to the condition of the animal at the onset and during the progress of a disease. Thus we have the symptoms connected with (a) the pulse; (b) the respiration; (c) body temperature; (d) the mucous membrane; (e) surface of the body; (f) secretions and excretions; and (g) nervous system.

The pulse is not as good guide to the condition of the sheep as in the horse or cow as it is too readily influenced by excitement, by the presence of strangers and unusual handling.

We obtain the pulse in sheep by pressing the femoral artery on the inside of the thigh. The pulse in the healthy sheep is subject to considerable variations, from 60 to 80 beats per minute, and when excited or nervous may run considerably above one hundred. The following varieties of pulse are recognized in disease; frequent or infrequent, quick or slow, large or small, hard or soft, and regular or intermittent. The frequency

of the pulse has reference to the number of pulsations per minute: quick or slow has reference to the time required for the pulse wave to pass; large or small to the volume of blood that passes; hard or soft to the sense of feeling while passing under the finger; and regular and intermittent to the interval between the beats. There may be a number of beats regular in time and then the missing of one or two, or there may be an acceleration of a few beats. The condition of the circulation may also be judged by placing the hands on each side of the chest as nearly over the heart as possible. This is applicable especially in lambs and sheep thin in flesh.

When the sheep is quiet, the number of respirations will vary from twelve to eighteen per minute: if excited, exercised, or when warm this number will be greatly increased. In most animals there is a comparatively close relationship between the respirations and pulse, (1 to 4 or 1 to 5), but in sheep this relationship is not very constant. In disease the respirations may be quickened and their character changed as in fever, pleurisy, peritonitis, etc. In abdominal respiration the movements of the wall of the chest are limited—as occurs in pleurisy, while in thoracic respiration the muscles of the abdomen are held rigid and the walls of the chest make up for the deficiency. This latter condition is seen in peritonitis.

In inflammatory conditions of the air passages, irritation from dust or parasites, the secretions are modified and there is dryness or discharge, and usually sneezing or coughing. There may be modified respiratory sounds that are of value in making a diagnosis.

The normal temperature of the sheep is subject to variation. It is taken per rectum, the ordinary fever thermometer being used. The variations are from 100° to 105° Fahrenheit. During exercise and when the weather or stable is warm and close, the body temperature is elevated: during cold weather or after drinking cold water it will be lowered. In order to get at the normal temperature it is well to take the temperature of several sheep in the flock.

In health the mucous membranes are usually of a pale reddish color. Exercise will cause them to become more vascular. When inflamed they are of a bright-red color. In collapse, internal hemorrhage, impoverished or bloodless conditions they are pale. In chronic indigestion the mouth is foul and soapy; if irritated, the mucous membranes are excessively moist, and if feverish they are dry In some of the parasitic and liver diseases they are yellowish.

The fleece should look smooth and have plenty of yolk: the skin should be of a light pink color. When the animal is diseased or is unthrifty, the wool may become dry and brittle, and the skin pale and rigid. If affected with external parasites, the fleece looks "taggy", or the wool lost over large areas, and the skin itself is changed. During febrile diseases the temperature of the skin is not uniformly distributed. If fatally affected the skin feels cold. When debilitated, especially if the debility be due to internal parasites, dropsical swellings may occur under the jaw and in different parts of the body.

The character of the excretions from the kidneys and bowels become modified in disease and should be considered in making a diagnosis of the different diseases.

The state of the nervous system is indicated by dullness, excitability, turning the head to one side, walking in a circle, throwing the head back, or by paralysis.

Administration of Medicine. Drugs may be administered by way of the following channels: (a) by the mouth, (b) by hypodermically injecting into the tissues beneath the skin, (c) through the skin, (d) by way of the air passages and lungs, and (e) per rectum. The most common method of administration is by way of the mouth in the form of a drench. This can be done when the sheep is in the standing position or when thrown on its haunches and held between the knees. The standing position is to be preferred and it is best to give the drench with a small dose syringe. Care should be taken to not throw the head too far back, espepecially if the drench is bulky or irritating, as a part may get into the air passages and cause serious trouble. If a prompt, energetic effect is desired, and the drug non-irritating, it may be injected into the tissue beneath the skin. In sheep, this method of administration is seldom used.

Liniments, blisters and poultices are applied to the skin for their local effect. Absorption does not readily take place unless considerable friction is used in applying the medicine or the outer layer of skin is removed by blistering or by other means.

Volatile drugs as chloroform, ether, etc., are rapidly absorbed by the enormous vascular surface of the lungs. Anesthetics are seldom used in this class of animals and when medicine is administered by way of the respiratory track it is generally used in the different respiratory diseases. This

is done by partly filling a pail with boiling water, adding to it an ounce or two of creolin, turpentine or whatever drug is desired and allowing the sheep to inhale the vapors as they rise from the pail. To direct the steam toward the animal's nose, a light stable blanket can be thrown over the head of the sheep and allowed to drop over the sides of the pail.

An enema or clyster is a fluid injection into the rectum and is for the following purposes: (a) to increase the action of a purgative; (b) to stimulate the peristaltic movement of the intestines; (c) for a local effect on the rectum, and (d) to administer medicine and supply food. An injection is generally given for its purgative effect and it is best to allow the fluid to gravitate into the bowels from a height of about two feet. The apparatus needed for this purpose is a funnel and two or three feet of rubber tubing with a nozzle at one end. Before introducing the nozzle into the rectum it should be lubricated with vaseline. In giving a large injection, it is best to elevate the hind parts of the animal.

DISEASES OF THE DIGESTIVE SYSTEM.

STOMATITIS. SORE MOUTH.

Causes. The lining membrane of the mouth of sheep is rather delicate, but so carefully do they select their feed that it is seldom injured. Stomatitis, or sore mouth may be seen as a complication in infections and febrile diseases. Young and debilitated lambs when kept in unhygenic quarters (poorly ventilated, filthy, damp stables) are prone to the ulcerative form of sore mouth. The disease seems to be communicated from one lamb to the other and is no doubt due to some of the pathogenic germs.

Symptoms. In simple stomatitis the parts are congested, swollen and inflamed. At first the lining membrane is dry, but in a short time the secretions become excessive and the saliva dribbles from the mouth. The decomposition of the food, etc., going on in the mouth gives rise to a very disagreeable odor. Eating is quite painful and the animal is generally unable to take food. Recovery usually takes place in a few days.

In the ulcerative form the gums become dark red, spongy and bleed easily. In a short time a part dies, sloughs out and a deep, ragged looking

ulcer forms. The ulcer can be seen on the lips and gums and may become quite extensive, the teeth loosening, dropping out and perforations occuring in the lips. Threads of saliva dribble from the mouth and the breath has a disagreeable odor. The lamb refuses to suckle, becomes weak and may have a foetid diarrhea. This disease frequently results in death in about one or two weeks and if recovery occurs it is very slow. The lining membrane of the fourth stomach may be reddened and the lungs inflamed and the seat of bloody exudations.

Treatment In simple stomatitis washing the mouth with antiseptic and astringent washes once a day is all that is necessary. A four per cent watery solution of boric acid can be used. Plenty of this solution should be used and the mouth washed thoroughly. The animal must be fed soft feeds and gruels. In the ulcerative form preventive measures are important. This consists in improving the hygienic conditions and isolating the sick lambs. The quarters should be cleaned and the floors and walls washed with a disinfectant. The local treatment consists in removing the dead tissue from the ulcers, washing the mouth with a two per cent watery solution of creolin and touching the ulcers with lunar caustic.

DEPRAVED APPETITE. WOOL EATING LAMBS.

This disease is more common in lambs than in older animals. The thriftiness of the lamb is interfered with and in a large per cent of cases may prove fatal. The loss due to the injury to the fleeces is of some importance from an economic point of view.

Causes. By some it is considered to be due to a depraved sense of taste and is classified as a nervous disease. In most cases it seems to result from example and improper food, especially food deficient in saline matter. Sheep shut up during the winter may get into the habit of chewing each other's fleeces. Lambs are especially apt to contract this habit when suckling ewes having long hair on the udder that is soiled with urine and faeces.

Symptoms. It may be sometime before symptoms of unthriftiness are manifested and outside of the loss to the fleece, no symptoms are noticed. Finally the digestive tract becomes involved, due to the irritation from the hair balls that accumulate in the stomach, digestion is deranged and the sheep loose flesh. The animals are sometimes consti-

pated or have a diarrhea. Death may be due to the small hair balls drifting along and obstructing the openings from the different apartments of the stomach, or as a result of the inflammation of the stomach, and intestines. The course of the disease varies from a few months to a year.

Treatment. Avoid keeping sheep in too close quarters and allow plenty of exercise. When the disease occurs on poor pasture a change to a better one and a liberal allowance of salt will prevent it, or a well balanced ration of grain can be added. The long wool on the udder of ewes should be clipped off and if the lambs contract this habit they must be separated from their mothers except when nursing. When indigestion is present the following bitter tonics can be given; bicarbonate of soda (two ounces), powdered gentian (one ounce), sulphate of soda (six ounces); mix and give one teaspoonful in the feed morning and evening.

ACUTE TYMPANITIS, BLOATING, HOVEN.

Bloating is more common among cattle than among sheep, but usually when it does occur a number of animals in the flock are affected. The disease is more common during late summer and early fall than at any other season of the year.

Causes. Diseases of the rumen or any part of the digestive track predisposes sheep to tympanitis. When due to these conditions, it usually takes on a chronic form. It may occur as a symptom of choking. A very common cause is succulent foods such as clover, rape, green corn, etc., especially if wet with dew or a light rain and when the animal is not accustomed to eating them. Frozen food and drinking large quantities of cold water after eating may sometimes cause a fermentation of the food in the rumen.

Symptoms. The abdomen is distended with gas and is larger than normal.The left flank is distended at first but when the gas forms in large amounts the whole abdomen becomes distended. This occurs very quickly, is elastic and resonant. The sheep stop eating and ruminating, look anxious, the eyes are prominent, the mucuous membranes are congested and faeces are expelled at irregular intervals. If not relieved the respirations become labored and the pulse weak. Saliva dribbles from the mouth. The animal becomes very stupid and finally sinks to the ground and dies. Death occurs as a result of the absorption by the blood-vessels of a toxic

product from the stomach and the interference with the aeration of the blood in the lungs due to the pressure on the air cells by the distended rumen. Acute tympanitis takes a very rapid course. If the gas escapes by way of the gullet or intestines a spontaneous cure may result.

Treatment. Preventive measures are important. A change to a succulent diet should be made gradually; musty grains, fodders, roots and frosted foods should not be fed to sheep. It is not best to allow a flock to graze in clover or eat any succulent food if wet with dew or light rain. The gas can be removed very quickly by puncturing the rumen with the trocar and canula. The seat of the operation is on the most prominent portion of the left flank. A small sized trocar and canula should be used and to guard against infection, it should be sterilized before using and the skin over the seat of the puncture washed with a disinfectant. The instrument is then plunged through the walls of the abdomen and rumen, the trocar withdrawn and the gas allowed to escape. Before withdrawing the canula the trocar should be replaced. It is always best after using the instrument to boil it in water. This will insure a clean instrument when needed. When a number of sheep in the flock are affected and there is a running stream in the pasture, it is best to drive them into it. The cold water coming in contact with the wall of the abdomen may stimulate the movement of the rumen and the gas will be then worked off by the natural passages. Dipping them into water will have the same effect. To prevent further fermentation, a tablespoonful of turpentine can be given in three or four ounces of linseed oil. The following receipt is useful; glauber salts (half an ounce), powdered gentian (one dram), aromatic spirits of ammonia (two drams), water (six ounces); mix and give as a drench.

CHRONIC TYMPANITIS.

Causes. The chronic form of tympanitis is generally due to some chronic disease of the digestive track. The persistence of some of the causes of the acute form may lead to the conditions becoming chronic.

Symptoms . The whole digestive system seems to lack tone and vigor, The bowels are irregular and the sheep falls away in condition quite rapidly. Instead of the bloating being severe and intermittent as in the acute form it is continuous and the gas does not form rapidly.

Treatment. The cause should be removed if possible, but in some chronic diseases this cannot be accomplished. The sheep should be fed

easily digestible food and have free access to plenty of common salt and pure water. As a laxative, four ounces of sulphate of soda can be given in about ten ounces of water. As a digestive tonic the following can be given; sulphate of soda (six ounces), powdered gentian (one ounce), and powdered nux vomica (one half ounce); mix, and give one tablespoonful in the feed morning and evening. Whenever necessary the trocar and canula should be used.

OVERLOADING OF THE RUMEN OR PAUNCH.

Causes. Overloading of the paunch is generally due to a sudden change from indifferent or poor food to palatable, succulent food, such as green clover, corn, sorghum, etc., when eaten in excess. If the digestive track is diseased and the movements of the paunch are weak overloading is very apt to occur.

Symptoms. The animal shows evidence of abdominal pain, does not ruminate or eat and is dull and feverish. The abdomen is distended on the left side, is not elastic as in tympanitis, but feels doughy when pressed on with the fingers. Some gas may form but the distension of the rumen is mostly due to the mass of food. When the disease is acute the symptoms are quite severe, the expression is anxious, the head is extended, eyes prominent and the respirations hurried. Constipation is a prominent symptom. Death may take place in a few hours but generally runs a course of several days. When the symptoms are mild, recovery is complete in a few days.

Treatment. The proper preventive precautions should be used. The sick animal should be subject to a rigid diet. Exercise and rubbing of the left flank may restore the normal movements of the paunch. Cold water injections are useful. If gas forms the trocar and canula must be used. As a purgative from four to six ounces of epsom salts can be given in plenty of water. To excite the movements of the paunch four drams of aromatic spirits of ammonia in two ounces of linseed oil can be given every few hours or the following tonic; powdered nux vomica (one half ounce, powdered ginger (one ounce), bicarbonate of soda (two ounces); mix and give a small tablespoonful in a drench morning and evening. Strychnine if given hypodermically in the region of the paunch may stimulate it to contract. Rumenotomy (opening the paunch in the left flank and removing about two-thirds of its contents with the hand) is not fol-

lowed by as good results as in cattle, and unless the operation is carefully performed will result in the death of the animal.

IMPACTION OF THE THIRD STOMACH. STOMACH STAGGERS.

Causes. This disease may occur during the course of digestive troubles or febrile diseases. The third stomach may become irritated and inflamed by sudden changes in the diet or by food not prepared for entrance to this apartment, as bran or meal swallowed hastily. Dried and innutritious food when eaten in excess and lack of water, are very common causes of impaction.

Symptoms. The disease usually develops slowly. The appetite is diminished, rumination occurs at irregular intervals, the sheep is dull and feverish and sometimes its movements are accompanied by a slight groan. Colicky pains and grinding of the teeth are sometimes present. The animal is constipated at first but if recovery occurs it may have a diarrhea. In the acute form nervous symptoms are sometimes manifested. The animal is dull, drowsy and listless and staggers when it walks. At times it becomes delirious, the eyes are prominent, it is restless and runs about coming in contact with whatever is in its way until it becomes exhausted or dies in a convulsion. The acute cases usually run a rapid course but in the chronic form the disease may last for days.

Lesions. The third stomach appears larger and harder than normal When cut into the food lying between the folds of the mucuous membrane may be so hard and dry that it can be powdered between the fingers. The lining membrane of the stomach is inflamed and the intestines may be also involved.

Treatment. The sheep must be subject to a rigid diet and given plenty of water. A purgative of epsom salts (six ounces in plenty of water) or a liberal allowance of flaxseed tea can be given. The action of the purgative should be aided by an injection. It is usually best to give a tonic of powdered nux vomica (one half ounce)and sulphate of soda(four ounces); mix and give one tablespoonful in a drench three times a day. If brain symptoms develop we should prevent the sheep from doing itself harm, and relieve the inflammation as much as possible by applying ice to the head. Irritating purgatives must not be used. When convalescence takes place, the animal should be fed laxative and easily digestible food.

CHOKING.

Causes. Greedy feeding animals are predisposed to choking. The foreign bodies present in the oesophagus or gullet generally consist of pieces of roots (potatoes, turnips, etc.) hay, grass, or ears of corn. Choking may be due to a diseased condition of the oesophagus as inflammation, paralysis, strictures and dilations.

Symptoms. The sheep stops feeding, looks anxious and saliva dribbles from the mouth. The respirations are hurried and more or less difficult. Bloating may occur. If the choke is complete the animal is unable to take liquid or solid food and death may occur in a few hours. If incomplete the symptoms are not marked and the accident generally terminates favorably.

Treatment. If the foreign body is lodged in the back park of the mouth or pharynx it can be removed with a blunt hook or a long iron spoon; if in the neck portion of the oesophagus, it may be worked back into the pharynx by pressure with the thumbs just below the object. If unable to force the object back into the mouth we must then resort to the probang and endeavor to force it on into the stomach. This instrument is several feet in length, hollow and has a bulb at the lower end. A probang for sheep should be half an inch in diameter, flexible and strong. In an emergency a light rod of hickory or elm rounded at both ends, the lower end covered with a piece of chamois firmly fastened, may be used. Heavy walled small rubber tubing will answer for the ordinary case. It is best to drench the sheep with an ounce or two of oil and smear the instrument with oil before passing it. The best position for the sheep is on its rump, the body gripped between the knees and the fore feet held with the hands. The operator should then grasp the tongue with one hand, draw it out of the mouth, rest the end of the probang against the hard palate and pass it rapidly into the oesophagus. It may require considerable pressure with the probang to remove the object, also the exercise of good judgment in doing this or the wall of the oesophagus may be injured.

DYSENTERY IN LAMBS. WHITE SCOURS.

Causes. This is not an uncommon disease of young lambs. A weak constitution and unhygenic surroundings, damp, dirty, overcrowded, poorly ventilated quarters, are important predisposing causes. Retention of the

meconium is at times a cause of scours. The most common causes are too much milk and variations in its character. It may be due to a contagious element that gains entrance to the body by way of the umbilical cord.

Symptoms. The lamb is dull, depressed, is careless of the teat and refuses to suckle. Constipation may precede the diarrhea. The lamb sometimes shows evidence of abdominal pain by switching the tail and acting uneasy. If fermentation takes place the abdomen is distended, The diarrhea is foul smelling, the tail, hips and legs soon become soiled, the animal is feverish, extremities cold, and rapidly becomes weak and emaciated. Death may follow as a result of exhaustion. If the cause of the disease is of infectious origin a large per cent. of the lambs will die.

Treatment. This is largely preventive. Dry, well ventilated, clean quarters should be provided and the lamb should be allowed plenty of exercise. If the mother's milk does not agree with the lamb and the fault is in the ration or general management, it should be corrected. If the diarrhea is due to a specific cause, the quarters must be cleaned and disinfected. As soon as the disease makes its appearance the umbilical cord of all new born should be swabbed with a ten per cent. solution of carbolic acid as nearly as possible. At first a laxative of castor oil (two drams), should be given; this can be followed by five or ten drops of laudanum three times a day. If there is much fermentation and the faeces foul smelling the following can be given; subnitrate of bismuth (one dram), salol (one half dram), and bicarbonate of soda (four drams); mix and divide into twelve powders; give one powder in a little milk three times a day. When extremely foetid the following recipe is of more benefit; calomel (one half dram) chalk (six drams); mix and give one teaspoonful in milk three times a day. It is best to diet the lamb and give the irritated stomach and intestines a short rest.

GASTRO-ENTERITIS. INFLAMMATION OF THE FOURTH STOMACH AND THE INTESTINES.

Causes. Poorly fed, weak and debilitated sheep are predisposed to this disease. Irritating foods, (rich, spoiled, or frosted foods), drinking water swarming with germs, over driving, and over feeding; exposure or anything lessening the resisting powers of the system may cause it. The

twisted stomach worm is a common cause of inflammation of the fourth stomach.

Symptoms. The appetite is poor or lost and the sheep stops ruminating. The pulse and respirations are quickened and the body temperature elevated. Colicky pains may be present and when pressure is made with the hand over the region of the fourth stomach (right hypochrondriac) it will sometimes cause the animal severe pain. At first the bowels are constipated, but this soon changes to a foul smelling diarrhea that is mixed with mucuous and sometimes tinged with blood. In severe cases the sheep suffers much pain, grinds its teeth strains and nevous symptoms are manifested. The general condition of the animal is greatly changed in a short time, becoming poor and weak, and it stands around with the back arched or mopes along after the rest of the flock. Death may occur in a few days or at most a few weeks. The prognosis is not very favorable.

Lesions The tissue changes are mostly in the small intestines and fourth stomach. The lining membrane is reddened, thickened and may contain a few ulcers. The walls of the intestines are softened and break when handled.

Treatment. If due to any mistake in the feeding or handling, it should be corrected at once. Plenty of exercise and access to pure water should be allowed. In summer time it is best to give the sheep the run of a grass lot where there is plenty of shade. In winter time they should be given warm, comfortable quarters. To relieve the constipation and remove the irritation, a laxative should be given; (epsom salts three to four ounces, or linseed oil five to ten ounces.) If the constipation persists this must be supplemented by an injection of warm water and glycerine. If the bowels move too freely and the sheep is in pain a teaspoonful of laudanum can be given two or three times a day or the following prescription can be used: subnitrate of bismuth (one ounce), salol (six drams), and bicarbonate of soda (three ounces); mix and give one teaspoonful every three or four hours. A tonic is sometimes indicated. When this is the case, artificial Carlsbad salts (equal parts of sulphate of soda, bicarbonate of soda, and chloride of soda) can be given. The addition of powdered gentian or nux vomica to the salts will greatly increase their value as a tonic.

INFLAMMATION OF THE LIVER.

PARENCHYMATIS. HEPATITIS. ACUTE YELLOW ATROPHY OF THE LIVER.

Causes. This disease is caused by excessive quantities of food too little exercise, musty, decomposed, irritating fodders, excessive heat, injuries to the liver, and damp swampy pastures. It is frequently seen in contagious diseases and parasitic affections of the liver. This condition is always present in lupinosis.

Symptoms. At first the symptoms may be obscure. Nothing characteristic is noted. The body temperature is elevated, the pulse is slow, or if the attack is severe, quickened, the appetite is lost or irregular, and the sheep acts dull and stupid. Jaundice may be present. The more characteristic symptoms are as follows: tenderness when pressure is applied over the region of the liver, (right side just back of the last rib); constipation followed by slightly colored, fetid diarrhea; colicky pains and a tendency to stagger. If the disease continues for some time the animal becomes weak and emaciated. Complications may occur, the most common being peritonitis. The prognosis is not favorable in the chronic cases.

Treatment. Preventive measures must be resorted to. The treatment consists in subjecting the sheep to a spare diet, applying a blister to the right side, giving a purgative of Epsom salts or calomel and repeating it if necessary. Artificial Carlsbad salts (equal parts of sulphate of soda, bicarbonate of soda, and chloride of soda) in teaspoonful doses should be given in the feed two or three times a day. When the acute symptoms have abated the following bitter tonic can be given; powdered gentian (one ounce) potassium chlorate (one ounce) bicarbonate of soda (two ounces); mix and give one teaspoonful in the feed twice a day.

JAUNDICE.

This is not a disease in itself but symptom of disease, and is called jaundice or yellows, because of the yellow color of the mucuous membranes, skin and different connective tissues of the body. Jaundice is nearly always present in sheep affected with the liver fluke, is quite common in sheep affected with the twisted stomach worm and is associated

with other parasitic disease. Many cases are seen, too, at slaughter houses the cause of which has not been determined.

Causes. Any condition that may impede the flow of bile toward the intestines may cause jaundice. Overfeeding, lack of exercise, gall-stones and concretions in the gall duct are common causes. When sheep are allowed to pasture on rich grass lands, the liver sometimes becomes affected and jaundice is seen as a symptom of this condition. The disease has been known to occur among sheep kept in low, damp undrained pastures. Jaundice is a symptom of a disease caused by a toxic substance contained in lupines.

Symptoms. The different tissues of the body are tinged with yellow, caused by the interference with the secretion of the bile from the liver and its reabsorption by the blood, from which it is deposited in the different connective tissues of the body. In the simplest form, the sheep has a slow pulse, is languid and sleepy, the appetite is irregular and the bowels constipated.

Treatment. When the disease is caused by faulty hygenic conditions, they should be corrected if possible. A changed diet is always advisable. To cause free movement of the bowel three or four ounces of Epsom salts can be given in a drench, or in chronic cases, calomel in ten grain doses repeated every two or three days if necessary. A liberal allowance of common salt is said to be a preventive. If the sheep is weak a tonic can be given of powdered gentian (one ounce), sulphate of soda (two ounces), and bicarbonate of soda (two ounces); mix and give one teaspoonful in the feed two or three times a day.

PERITONITIS. INFLAMMATION OF THE LINING MEMBRANE OF THE ABDOMEN.

Causes. Peritonitis may follow as a result of castration. It is not uncommon for it to occur as a complication of a difficult birth or an inflammation of an internal organ. Exposure, poor care, blows or wounds on the abdominal wall, and a rupture of the stomach, intestines or womb may cause this disease.

Symptoms. The most prominent symptom is pain. The sheep moves stiffly, the hind limbs are dragged, the back arched and the abdominal wall is held as rigid as possible. Pressure on the abdominal wall causes

pain. The body temperature will vary. In some cases there is no elevation of temperature in others it is quite high. The sheep may be constipated or have a diarrhea. When fluid is present in the abdominal cavity we can detect it by placing the ear against the wall and listening to the abdominal sounds. The prognosis is not very favorable. The animal may die in a few days. When the disease is prolonged for several weeks it ends in a chronic peritonitis. In favorable cases the symptoms gradually subside and recovery takes place in a week or ten days.

Lesions The peritoneum is inflamed and there is an exudate in the abdominal cavity. This may contain fibrin or pus and may have a disagreeable odor. Different internal organs may take part in the inflammation.

Treatment. Preventive measures consist in using the proper antiseptic precautions when castrating sheep and not operating on the lambs when young. The sheep should be kept as quiet as possible, given good quarters and care and fed nothing but easily digestible food. To clean out the intestines and remove the bacteria which becomes a source of danger, a laxative must be given and injections frequently used. Mucilagenous drinks are advisable. To relieve the pain the following is useful: laudanum (one ounce), and linseed oil (three ounces); mix and give half a tablespoonful every three or four hours. To relieve the inflammation and lessen the pain, hot water fomentations or ammonia water can be applied to the abdominal wall. In cases having high temperatures, it is best to give the following febrifuge: acetaniled (one ounce), quinine sulphate (one ounce), and powdered nux vomica (one half ounce); mix and divide into twelve powders; give one powder every three or four hours. To relieve the diarrhea and fermentation in the intestines the following can be used: subnitrate of bismuth (one ounce), salol (one and one-half ounces), and bicarbonate of soda (three ounces); mix and give in one or two teaspoonful doses every three or four hours.

DISEASES OF THE URINARY ORGANS.

ACUTE CONGESTION OF THE KIDNEYS.

Causes. During the course of some contagious diseases the kidneys

may become the seat of inflammatory process. Food containing toxic elements, irritating drugs and cold are common causes.

Symptoms. The sheep lags behind the flock and is often seen lying down. The back is arched, the loins tender, the gait stiff and straddling and frequently it strains and passses bloody colored urine. As the disease advances the animal becomes weak, dull and stupid and when it walks, the gait is uncertain and it frequently stumbles. Death may take place in about a week. If the disease is mild recovery usually occurs in a few days.

Lesions. The kidneys are reddened and larger than normal; the kidney tissue becomes friable and in some cases almost like pulp.

Treatment. A sudden change from a dry diet to grass early in the spring should be avoided by feeding the sheep a little roughness or grain the first few days they are turned out. Irritating drugs whether applied to the skin or given internally must be used cautiously. After the disease has developed the animal must be given good, nourishing food and comfortable quarters. Plenty of oil or flaxseed meal is a very useful food in this disease. The bowels must be kept loose by feeding laxative food or by frequent doses of castor oil. The following preparation can be given; powdered nux vomica (one ounce), sulphate of quinine (one ounce), salol (one half ounce); mix and give in teaspoonful doses three times a day.

INFLAMMATION OF THE KIDNEYS. ACUTE NEPHRITIS. BRIGHT'S DISEASE.

Causes. Congestion of the kidneys may terminate in an inflammation. The common causes of nephritis are similar to those causing a congestion of these organs.

Symptoms. pain is not as prominent a symptom of this disease in sheep as in other domestic animals. There may be considerable fever and a weak pulse. The urine is passed in small amounts and at frequent intervals. Toward the latter stage of the disease, the urine may be tinged with blood and the animal have convulsions. Unless the inflammation terminates in the early stages of the disease, different organs of the body become affected.

Lesions. The kidneys are enlarged, mottled, of a red or yellowish color. Large abscesses sometimes form in the kidney tissue.

Treatment. The sick sheep must be given comfortable quarters. Mucilaginous drinks are indicated. Counterirritants in the form of hot compresses to the loins will help in relieving the pain and inflammation. We must help in getting rid of the waste products formed in the body by the use of purgatives and diuretics. As a diuretic, bicarbonate of soda (one teaspoonful) and iodide of potassium (twenty grains) can be given in the drinking water two or three times a day. Castor oil can be given to keep the bowels lax. The same tonic recommended in congestion of the kidneys can be given.

INFLAMMATION OF THE BLADDER.

Causes. Irritating drugs (cantharides, turpentine, etc.) when given in large doses may be present in the urine in large enough amounts to irritate and inflame the lining membrane of the bladder. Irritation due to retention of the urine and exposure to cold may also cause it.

Symptoms. The body temperature may be higher than normal. The sheep walks stiffly, strains frequently and passes a small amount of urine. The lining membrane of the bladder is inflamed and thickened. In advanced cases due to the shedding of the epithelium, there may be large raw surfaces on the membrane.

Treatment. Irritating drugs should not be used in a careless manner. If due to retention of the urine the cause must be removed if possible. The medicinal treatment consists in administering the remedies that will modify the inflammation. Mucilaginous drinks are indicated and the sheep should be kept quiet and the bowels lax. The following can be given: salol (one-half ounce), powdered nux vomica (one ounce), and chlorate of potassium (one and one-half ounces); mix and give in teaspoonful doses, in the feed twice a day.

RETENTION OF URINE.

This is not a disease in itself but a symptom of disease, and is more common in the male than in the female.

Causes. The causes of retention of the urine are as follows: foreign bodies in the bladder (calculi), sediment in the S curvature of the urethra of the ram, pressure on the urethra by a tumor, inflammation of the sheath, displacement of the uterus, paralysis of the bladder, general weakness and infrequent urination. The feeding of a large ration of roots will also cause the trouble especially in males.

Symptoms. The sheep refuse to eat, is drowsy and weak. Frequently strains and tries to urinate, but no urine is passed. Sometimes the urine runs off drop by drop. If not relieved the bladder is ruptured, or the blood becomes charged with poisonous substances and the disease terminates fatally, uraemia.

Treatment. If a calculus is present in the bladder it must be removed if possible. In spasm of the neck of the bladder morphine or belladonna can be given, and when paralyzed, it is necessary to pass the catheter frequently. If due to an inflamed prepuce, the part must be washed with warm water and castile soap, and vaseline applied to the part.

DISEASES OF THE RESPIRATORY ORGANS.

COLD. CATARRH. CORYZA.

Causes. This affection is due principally to exposure to cold, rainy weather, and in some years, is very prevalent. Too early clipping may also be a cause. Confinement in basements of barns without sufficient ventilation will produce it. Coryza is sometimes caused by the larva of the sheep bot fly.

Symptoms. The membrane lining the anterior air passages is irritated, reddened and inflamed and the sheep sneezes frequently or has a slight cough. During the early stage of the inflammation, the nasal membrane is red and dry. It soon becomes moist, the discharge from the nostrils is watery at first, in a short time may be changed to a heavy white flocculent, purulent fluid. The mucuous membrane of the eye may take part in the inflammation; sometimes a slight fever accompanies the cold. If the discharge persists the animal becomes emaciated. If the attack is severe and the exposure continues, the inflammation may extend to other parts of the respiratory track. The prognosis is usually favorable.

Treatment. The preventive measures consist in providing the flock with good, clean, dry and well ventilated quarters, when necessary and waiting until a favorable season before clipping them. Usually, good quarters is all the treatment required for the sick animals. Steaming the sheep will relieve the irritated membranes. The steaming should be kept up for about half an hour and repeated two or three times a day. Early in the

attack, a laxative can be given, and if necessary, febrifuges. Liquor ammonia acetate is sometimes given in half ounce doses every few hours. A nourishing, easily digested diet will be of much benefit. If due to bot fly larva, the only successful treatment is to trephine into the sinuses of the head and remove the parasites. If the catarrh develops early in the fall and the sheep are in good condition; they may be turned over to the butcher, if in the spring, good food with grain will carry them through until the fly comes away.

INFLAMMATION OF THE LARYNX AND PHARYNX.

SORE THROAT.

Causes. Sore throat may occur independently of simple catarrh, but more commonly is seen as a complication of that disease. Exposure to frequent colds, changes in climate, wet, chilly weather and such unsanitary surroundings as hot, close, dirty buildings are common causes of sore throat.

Symptoms. When caused by the inflammation spreading from the nasal cavities to the larynx and throat the early symptoms are the same as described in cold in the head. When the throat becomes inflamed, however, the cough is harder and more troublesome. Pressure over the outside of the region causes the animal pain and provokes coughing. In severe cases the throat is swollen, saliva dribbles from the mouth and the sheep is unable to take food. If the nostrils become plugged by the secretions the animal breathes through its mouth. Ordinarily, recovery occurs in one or two weeks.

Treatment. The ventilation of the sleeping quarters must be looked after carefully. The sheep house must be clean, free from draughts and not over-crowded. The same treatment used in cold in the head is indicated in this disease; easily digested feed, laxatives, hot water inhalations, and febrifuges. After the first few days, the wool on the throat can be clipped off and the following liniment applied: spirits of turpentine, aqua ammonia and linseed oil (equal parts of each); mix and rub on the throat once a day.

BRONCHITIS. INFLAMMATION OF THE BRONCHIAL TUBES.

Causes. Bronchitis is more often seen in the spring and early fall than at any other season of the year and may exist as a regular enzootic among sheep. The same conditions giving rise to cold in the head and sore throat may cause bronchitis, or it may occur as a complication of some of the infectious diseases.

Symptoms. The sheep is depressed and feverish, the eyes watery and visible mucous membranes reddened. The cough is hard and dry and usually there is a mucuous discharge from the nostrils. If we place the ear to the walls of the chest we hear louder bronchial sounds than normal. In the croupous form of bronchitis the respirations are more noisy and labored and disponea may occur. When the disease is mild the symptoms are not marked, recovery takes place in a few days. Unless complications occur the prognosis is favorable.

Treatment. The treatment for common cold is usually sufficient. A cathartic of Epsom salts (three or four ounces) can be given. In the early stages of the disease febrifuges and expectorants should be given in order to lower the body temperature and stimulate the secretions of the inflamed mucous membranes. The following can be given: liquor ammonia acetate in half ounce doses every three or four hours; or potassium bicarbonate (seven drams), ammonia carbonate (seven drams), and powdered digitalis (one half dram); mix and divide into eight powders; give one powder three times a day.

CROUPOUS PNEUMONIA.

Causes. Too warm buildings, heavy fleeces and sudden plethora predispose sheep to pneumonia. It may follow as a complication of bronchitis. A common cause of pneumonia is dipping and shearing during changable seasons of the year. Catarrhal pneumonia is usually due to the lung worm of sheep.

Symptoms. The disease generally takes a very acute form. The body temperature is high; the pulse and respirations quickened; nostrils dilated and the breathing labored, causing the flanks to heave. The sheep eats and ruminates irregularly or not at all, has a painful cough and a distressed anxious look. If the disease is going to terminate unfavorably the breathing becomes more difficult, the animal stands in one position with the head extended and the nostrils dilated. When the disease takes

an unfavorable turn, the respiratory sounds are deadened and the pulse rapid and almost imperceptible. In sheep pneumonia does not run through the different stages as in some of the other domestic animals. Death sometimes occurs in the first stage, the period of engorgement.

Treatment. The preventive treatment consists in avoiding such conditions as may cause the disease. When the pneumonia sets in the sick animal must be provided with comfortable, clean, well-ventilated quarters and kept as quiet as possible. As soon as the first symptoms are manifested a laxative of castor oil (two or three ounces), or in strong plethoric animals a purgative of Epsom salts (four ounces in warm gruel) can be given. The diet should be light and easily digested. The following febrifuges can be given: liquor ammonia acetate in half ounce doses every three or four hours; or acetanilid (one and one-half ounces), bicarbonate of soda (one ounce), and powdered nux vomica (two drams); mix and divide into eight powders; one powder can be given in a drench every four hours. As a counterirritant to the walls of the chest aqua ammonia can be used.

PLEURISY, INFLAMATION OF THE LINING MEMBRANE OF THE CHEST.

Causes. Pleurisy may occur as a complication of pneumonia, the inflammation extending from the lungs to the pleural membrane. Clipped sheep, or sheep that have lost wool as a result of scab if not sheltered or protected during the changeable seasons of the year are subject to pleurisy. Washing and dipping during the cold weather or injuries to the chest sometimes cause it. Rheumatic affections may be accompanied by pleurisy.

Symptoms. The general symptoms are as follows: high fever, quick, small pulse, quickened respirations (the expiration being prolonged and the inspiration short and arrested), appetite impaired, rumination suspended. The animal holds the walls of the chest as rigid as possible and when the spaces between the ribs (inter costal spaces) are pressed upon it causes pain. The cough is short, dry and on account of the pain suffered whenever the ribs are moved, it is suppressed as must as possible. In the first stage of the disease when we listen to the respiratory sounds, friction sounds are heard, due to the dried, inflamed membranes rubbing against each other whenever the animal breathes. Later these sounds disappear

and we may be able to detect fluid in the pleural cavity (hydrothorax.)

Treatment. The same preventive measures and the same general line of treatment laid down in pneumonia is indicated here. After the first day or two, aqua ammonia and linseed oil can be applied to the walls of the chest by parting the wool and applying it in lines. If there is a collection of fluid in the chest cavity and the heart action is weak, the following preparation can be given: tincture of digitalis (one ounce), iodide of potassium (one ounce), and enough water to make eight ounces. One tablespoonful can be given every four hours. In instances where the sheep cannot receive careful attention a little nitrate of potassium can be given in the drinking water.

HYDROTHORAX. FLUID IN THE CHEST CAVITY.

Causes. This is a common complication of pleurisy. If the flow of blood in the large veins is impeded or if there is organic heart or chronic kidney trouble present, this disease may occur independently of any inflammation. When this is the case, dropsical swellings are present in different parts of the body.

Symptoms. In pleurisy, when the acute symptoms subside quickly, it indicates a collection of fluid in the chest cavity. If but a small collection of fluid is present the pain is lessened, but if it forms in large amounts it presses on the lungs and heart, seriously interfering with the functions of these organs. By placing the ear to the side of the chest the fluid can be detected. When the ear is applied to the lower part of the chest walls no respiratory sounds are heard, but if applied high up the sounds may be normal. The exudate in the thoracic cavity is not always the same in character. It may be of yellow, citron or red color, grayish or muddy if it contains pus or fibrin, and clear, limpid, or transparent if a true dropsical effusion. Dropsical swellings may be present in different parts of the body.

Treatment. The sheep must be given good care. Counter-irritation to the chest walls, as in pleurisy is indicated. If constipated, a cathartic must be given. To help get rid of the effusion, the following prescription may be given: tincture of digitalis (one ounce), iodide of potassium (one ounce), fluid extract of gentian (one ounce), and enough water to make eight ounces; mix and give one tablespoonful three times a day.

When the sheep begins to improve one teaspoonful of iron sulphate can be given in the feed two or three times a day. In bad cases, tapping the chest and drawing off the fluid by means of the trocar and canula is the only successful treatment.

DISEASES OF THE CIRCULATORY SYSTEM.

INFLAMMATION OF THE HEART AND ITS MEMBRANES.

Causes. Sharp objects as needles, wire, nails, etc., that are taken into the stomach along with the food and finally pass through the walls of the stomach and injure the heart and its coverings are common causes. Pericarditis (an inflammation of the coverings of the heart) and endo-carditis (an inflammation of the lining membrane of the heart) are sometimes seen in rheumatic diseases. Pericarditis may occur as a complication of pleurisy, the inflammation extending from the pleural membrane to the pericardium.

Symptoms. When caused by foreign bodies penetrating the pericardial sack from the stomach, symptoms of indigestion may precede the cardiac symptoms. The most prominent symptom is pain. The pulse beats are irregular, the temperature elevated, and the sheep weak. The expression is anxious and denotes suffering, the animal does not lie down and may remain in one position for some time. By placing the ear just over the region of the heart we may be able to detect the heart sounds. If no fluid is present in the pericardial sack we sometimes hear friction sounds; if fluid is present, fluid sounds. In endocarditis we may hear a blowing sound. In the beginning of the disease the heart beats are strong, palpitating and bounding and the breathing is difficult and distressed. The general condition is soon changed and the sheep becomes thin and weak. The prognosis is very unfavorable.

Treatment. When the disease is due to the presence of foreign bodies no curative treatment can be given. The sheep should be given a cathartic of Epsom salts (three ounces). To regulate the action of the heart belladonna or digitalis can be given at short intervals and when recovery begins, bitter tonics. The animal must be kept quiet and as comfortable as possible.

PALPITATION. THUMPS.

Causes. Palpation is generally seen in animals that are in a weak, anaemic, bloodless condition and appears under the slightest exciting circumstances. In acute inflammatory diseases of the heart or its membranes, palpitation is generally a prominent symptom.

Symptoms. When the palpitation is due to a weak anemic condition, the animal is emaciated, the skin and mucuous membranes pale and there may be local dropsical effusions in different parts of the body. In these cases the palpitation depends on some excitement and is regular, the jerking of the muscles in the region of the flank corresponding as a rule to the heart beat. Abnormal heart sounds are absent.

Treatment. Keep the sheep quiet and avoid exiciting it. When associated with anaemia, bitter tonics should be given along with good nourishing food. One teaspoonful of iron sulphate can be given in the feed twice a day. The following prescription is useful: fluid extract of gentian (one ounce), tincture of digitalis (two drams), and enough water to make eight ounces; mix and give one tablespoonful three times a day.

ORGANIC DISEASES OF THE HEART.

The short term of life and the method of handling sheep make such organic heart troubles as fatty degeneration, enlargement, dilation and valvular diseases of the heart quite rare. In old overfed, pampered sheep, and those fitted for show purposes the fat may accumulate in and around the heart muscles, replacing the muscular tissue and interfering with the action of the organ. Dilation of one or both sides of the heart may accompany fatty degeneration. In these cases the sheep should be kept quiet and the forcing system of feeding abandoned or the animal sold to the butcher as soon as possible.

DISEASES OF THE NERVOUS SYSTEM.

ENCEPHALITIS. INFLAMMATION OF THE BRAIN.

Causes. Injuries to the brain due to blows on the head from a whip or club, or to the sheep fighting among themselves may cause it. Overfeeding with grains or feeds rich in albumenoids or proteids (peas, beans,

cotton seed, gluten, oil meal, etc.,) unhygenic surroundings (close, damp, poorly ventilated quarters) and violent exertion during the hot weather are common causes. Spoiled fodders and grains that are mouldy, or contain smut and microbes are probable factors in inflammation of the brain. Certain substances, containing narcotic substances, as intoxicating rye grass will sometimes cause it. The larva of the oestrus ovis or grub of sheep will when present in or on the surface of the brain irritate and inflame it.

Symptoms. The sheep is often drowsy, stupid and disinclined to move, the head is hot, carried upwards or to one side, the eyes fixed, rolled up and reddened, the pupils dilated and the gait stiff and staggering. The sheep may be excited, charge objects, work the jaws, froth at the mouth and bleat. When excited the respirations and pulse are usually rapid. Sometimes it is seen with its head pushed against the wall or lying by itself with the head low or turned backwards. Finally paralysis sets in. The prognosis is very unfavorable.

Treatment. If the disease is due to unhygienic conditions, spoiled foods, or a faulty ration, the cause must be removed or a number of the flock may become affected. As soon as any of their number take sick, a purgative of Epsom salts (from four to six ounces) should be given to the whole flock. The sick animal or animals must be kept in a cool, quiet place, and cold in the form of wet cloths or ice applied to the head as long as it feels hot. When excited and feverish, acetanilid in one dram doses should be given, or chloral hydrate in one or two dram doses every four hours. As soon as possible, in order to restore tone to the nervous tissue the following can be given: iodide of potassium (one ounce), fluid extract of nux vomica (six drams), and enough water to make eight ounces; mix and give half an ounce three times a day. When sick and during the convalescent stage, the bowels should be kept lax and the animal fed an easily digestible ration.

HDROCEPHALUS. DROPSY, OR WATER IN THE VENTRICLES OF THE BRAIN.

This disease is frequently seen in lambs, many times they are born with it, the head being so enlarged that delivery is quite difficult. If this is the case the lamb is generally dead, or if alive, rarely lives more than a few days.

Causes. In-breeding is said to cause it. Its prevalence in some localities would suggest some local influence, as the food and water as factors in causing the disease.

Symptoms. The head is large in proportion to the size of the rest of the body. The sheep is lazy, dull, stupid, the gait staggering and uncertain and the animal is not inclined to move. Sometimes the disease is complicated by digestive disorders. Uusally the head is twisted on the neck or turned to one side.

Treatment. If the disease is caused by mistakes in breeding, the management of the flock must be changed. If to local conditions it would be advisable to move the flock to another location. Medicinal treatment is of no use.

CEREBRO SPINAL MENINGITIS. INFLAMMATION OF THE COVERINGS OF THE BRAIN AND SPINAL CORD.

Causes. But little is known regarding the cause of this disease. It is probably due to several different toxic principles, but by some it is claimed to be due to a specific cause (a germ). The disease is frequently seen in young animals, generally during the winter and spring.

Symptoms. The head feels hot, the mucuous membranes are congested and the pupils dilated. The animal grinds its teeth, saliva dribbles from the mouth, the lips are contracted, it is weak and dull and shows a tendency to move in a circle. We soon find it stretched upon the ground as if paralyzed, the head thrown back and the muscles of the jaw, neck and back rigid. Sheep in this condition are very sensitive and may have convulsions. Death usually occurs in a few hours, or a few days, but sometimes it lives for several weeks. The prognosis is very unfavorable.

Treatment. The treatment is the same as that recommended in inflammation of the brain. If mistakes in the care and feeding of the sheep exist, they should be corrected at once. If a number of animals in the flock are affected, the sick should be separated from the healthy ones, and the sheep house and pens cleaned and disinfected.

APOPLEXY. SOFTENING OF THE BRAIN.

Causes. Any condition increasing blood pressure in the brain may cause this disease. In highly fed, pampered sheep, excitement, extreme heat and over-exertion may produce it. Mechanical injuries may also cause it. If degenerative changes occur in the walls of the cerebral vessels,

they become so weak that the slightest increase in blood pressure will rupture them. Floating particles (emboli) in the blood stream may plug a cerebral vessel, cutting off the blood supply to a part, thus bringing about apoplexy, not by pressure on the nerve tissue, but from anaemia.

Symptoms. As a rule the disease comes on suddenly without our noticing that the sheep is sick. In the acute cases it staggers, falls, there is a complete loss of consciousness, convulsive movements of the legs and in a short time the animal dies. In most cases, however, it is dull, unsteady in its gait, or shows a tendency to move in a circle. The pulse is weak, respirations slow, labored, irregular and stertorous, the visible mucuous membranes intensely congested, eyes dilated and pupils enlarged, sometimes more in one eye than the other. The paralysis may be general or involve only certain muscular groups.

Treatment. In acute cases, this is very unsatisfactory. In mild attacks at the outset, cold applications to the head and bleeding can be practiced. The sheep must be kept perfectly quiet. When able to swallow, a purgative of Epsom salts (four to six ounces) can be given. Bromide of potassium should be given in small doses to keep down the force of the circulation. To help absorb the exudate or blood clot that may be present and restore tone to the nerve tissue the following can be given; iodide of potassium (one ounce), powdered nux vomica (six drams); mix and divide into twenty powders; give one powder three times a day. A course of vegetable and mineral tonics together with a laxative diet is advisable as soon as the animal shows signs of improvement.

EPILEPSY. FITS.

Causes. Epilepsy may be due to lesions in the brain, walls of the cranium, or spinal cord. Disorder in the cerebral circulation or such abnormal conditions as are present in uremia, lead poisoning, etc., may bring on this condition. In young animals intestinal parasites and irregular management and feeding are common causes.

Symptoms. Epilepsy will vary in intensity and duration, depending on the cause. The sheep will suddenly stop ruminating or eating, look about in a stupid manner and after turning or staggering, fall to the ground and have violent convulsions. The fit may last but a few seconds or minutes, and the animal will get up and go to feeding as though nothing had happened. Generally, it continues dull and sleepy for some time.

Treatment. If the cause of the epilepsy is known and can be removed, the treatment must be directed to the cause. When a sheep is in a fit, it should be prevented from injuring itself and cold water dashed on the head. Bromide of potassium is useful in treating epilepsy and should be given in from ten to thirty grain doses in a drench, three or four times a day. Iodide of potassium may also be given. Out door life, moderate exercise and bitter or iron tonics are very important.

PARALYSIS.

Causes. Pressure from diseased vertebrae, tumors or abscesses, and growing parasites on the nerve tissue of the spinal cord or brain, will cause a paralysis of that part of the body that depends on the injured nerve tissue for its nerve supply.

Symptoms. The paralysis may come on suddenly and the symptoms manifested resemble those seen in inflammation of the spinal cord or brain. Generally, it comes on gradually and may involve a certain set of muscles or organs, or may be general with the special senses clear. The parts affected will point to the seat of the trouble. Sensory troubles, increased sensibility or loss of sensibility, are sometimes present.

Treatment. The sheep should be made as comfortable as possible and fed easily digested food. To keep the bowels lax, it is advisable to administer a laxative every few days. Nerve tonics such as strychnine (one thirtieth of a grain) or powdered nux vomica (thirty grains) should be given in the feed two or three times a day. Treatment is generally unsuccessful and it is usually advisable to slaughter the animal.

HEAT STROKE. HEAT EXHAUSTION.

Heat exhaustion generally follows violent exertion during the hot weather. The symptoms are as follows: weak, small pulse, general depression, muscular weakness and collapse. The animal soon goes down, is restless and finally dies.

Treatment. The treatment consists in diffusible stimulents (alcohol in half ounce doses every few hours) tincture of digitalis in teaspoonful doses to sustain the heart and cold douches on the head and fore parts. If the body temperature is sub-normal, warm baths can be given.

SUN STROKE

The cause of sun stroke is exposure to severe summer heat and may

occur during or after hard exercise, especially if the sheep is fat or out of condition.

Symptoms. The symptoms are as follows: rapid breathing, open mouth, reddened, prominent eyes, high temperature, unsteady gait, convulsions and death. Unless the treatment is prompt, the prognosis is unfavorable.

Treatment. During warm weather conditions that may cause sun stroke should be avoided. When a sheep becomes affected, place it in a shady place and apply cold water to the head, neck and entire body. This can be done by placing the sheep in a tub or tank for a few minutes. The medicinal treatment is the same as that used in heat stroke.

DISEASES OF THE REPRODUCTIVE SYSTEM.

ABORTION.

Abortion occurs when the foetus is expelled twenty days before the normal period. It is not a common accident among ewes.

Causes. Abortion may be due to the following causes: ergotized grass, acrid plants; frozen food or water if taken in large amounts, filthy water, indigestible foods, or food of a bad quality. Injuries to the abdomen, general diseases, excitement, over-exertion and fear or fright produced by dogs. Poorly cared for and neglected ewes may abort as well as extremely fat ones.

Symptoms. The symptoms will vary and in some cases are so trifling that the accident is not noticed at the time. The ewe may, however, become quite uneasy and bleat continually. The genital organs are enlarged, a glazy like discharge is seen around the lips of the vulva and sometimes a portion of the foetal membrane is visible. Soon after these symptoms are manifested, the foetus is expelled. If the abortion becomes complicated by retention of the foetal membranes, the ewe will remain away from the rest of the flock, is dull, feverish and refuses to eat. If properly treated, these symptoms pass away in a short time. It may terminate in an inflammation of the womb, but this is not common. The lamb is usually dead.

Treatment. The treatment is mainly preventive and consist in avoiding such conditions as may cause the accident. When the maternal pas-

sages are not prepared for the entrance of the foetus, the ewe is in pain and becomes very restless. The pain can be relieved and the parts relaxed somewhat by hot applications to the region of the pelvis. The ewe must be given a good bed and kept in a quiet place away from the rest of the flock. If weak a stimulant (whisky) can be given. If the act of parturition is prolonged, the necessary aid must be given but it is never best to meddle too soon. If the membranes do not come away within a day or two after aborting they must be removed with the hand and the uterus and maternal passages washed with a watery solution of creolin (two parts of creolin to ninety-eight parts of water). We must not neglect the removal of the after birth or its retention will be followed by bad results.

EVERSION OF THE UTERUS AND VAGINA.

Causes. It consists in a displacement of the parts, in which the uterus and vagina are turned partially or completely inside out, the everted portion of the uterus escaping through the opening of the neck of the womb and projecting like a large tumor from between the lips of the vulva.

Treatment. The eversion must receive prompt attention or there is danger of the tissues becoming torn, bruised or gangrenous. The parts must be first cleaned and the swelling reduced by washing them with a warm watery solution of creolin. After this has been accomplished, the next step is to replace them. The ewe should be turned on her back and the hind parts elevated and the uterus and vagina returned to their natural positions. Strong stitches should next be taken in the skin on each side of the vulva or through its lips, and crossed in such a way as to prevent the recurrence of the displacement. Care must be taken that the stitches do not interfere with urination. If the uterus is badly lacerated or gangrenous, it can be amputated and the ewe prepared for the butcher.

INFLAMMATION OF THE VAGINA AND UTERUS. VAGINITIS. METRITIS.

Causes If during labor the walls of the vagina or uterus become torn or bruised, germs may enter and bring about an inflammation of the parts. It may follow retention and decomposition of the foetal membranes. Dirty instruments and dirty hands at the time of birth frequently carry disease

producing germs into the uterus. Conditions here are favorable for their development and may result in a fatal inflammation of tne parts.

Symptoms. The ewe is feverish, dull and weak; the appetite is impaired and she frequently strains as if to pass urine. There is more or less discharge from the inflamed parts and the lining membrane of the vulva is red and tumefied. These symptoms may pass off in a few days or become worse. The animal will stand with the abdomen tucked up or lie down most of the time. The ewe may be constipated or have a diarrhea, suffer considerable pain and have a high temperature. The prognosis is generally unfavorable when the disease takes a turn of this kind. In some cases the inflammation becomes chronic. It is then called leucorhoea, the principal symptom being the discharge from the vagina.

Treatment. The preventive treatment consists in practicing the proper antiseptic precautions at the time of the birth and removing the foetal membranes before decomposition has occurred. Before assisting in removal of the foetus the hands and instruments must be cleaned by washing the hands and allowing the instruments to lie in a two per cent. watery solution of creolin. The maternal passages and uterus should then be washed with a similar antiseptic solution. If the parts become inflamed, they must be washed daily and when the animal is feverish, the following febrifuge can be given; acetanilid (six drams), quinine sulphate (three drams), calomel (one dram), powdered nux vomica (two drams); mix and divide into eight powders; give one powder in a drench every four hours.

MAMMITIS INFLAMMATION OF THE UDDER.

Causes. Congestion of the mammary glands is due to various causes. Exposure to cold, bruises from the head of the lamb, lying on stones or on the ground in damp folds, yards or pastures, and irritation from retained milk, are common causes of inflammation of the udder.

Symptoms. In most cases the inflammation does not cause the animal much pain and disappears in a few days. It may, however, if neglected, become serious. The udder will then become swollen and painful, the skin covering it red and shiny, and later abscesses may form. The gland secretes but little milk and it is frequently coagulated or contains pus. The ewe looses flesh, is feverish and has a poor appetite.

Treatment. In mild casees of mammitis but little treatment is neces-

sary. It is generally advisable, however, to diet the animal. When feverish, a purgative of Epsom salts (three or four ounces) should be given in a drench. The following ointment can be rubbed on the inflamed gland twice a day; vaseline (four ounces), camphor ointment (two ounces), extract of belladonna (one half ounce); or a linament of linseed oil (six ounces) and carbolic acid (one dram) can be used. When the milk is clotted or contains pus, it must be drained off wtih a teat siphon once or twice a day and a two per cent. solution of creolin injected into the gland. A convenient apparatus for this is a teat siphon with about a foot or two of rubber tubing attached and carrying a small glass funnel at one end.

CASTRATION.

Castration of male lambs is best done when the animal is from two to six weeks old and in strong, healthy lambs, the operation may be performed as early as the third day. Flockmasters who allow the lambs to become two or three months old usually suffer some loss, even when the operation is carefully performed.

The operator should provide himself with a table, castrating knife, a pan or pail containing an antiseptic solution and an assistant, to catch and to hold the lambs. When the knife is not in use it should be dropped into the antiseptic solution. The assistant catches the lamb and holds it in a convenient position on the table. The region around the scrotum should be washed with an antiseptic, and if covered with wool, it should be clipped to insure cleanliness. The end of the scrotum is then cut off and each testicle in its turn is drawn out with the thumb and forefinger of the left hand, until the spermatic cord is ruptured. Sometimes it is necessary to pull out the testicle and scrape the cord with the edge of the knife until it breaks off. After removing the testicles if the opening in the scrotum is small, it should be enlarged. This is necesary as there is danger of the margins of the incision adhering before the part si healed, thus interfering with the draining off of the pus and endangering the life of the animal. In castrating a buck, it is necessary to confine him in some way. He should be laid on his back on the ground, and the hind legs held by an assistant, or tied in such a way as to prevent his struggling. On account of their being more danger from hemorrhage, it is advisable to scrape the spermatic cord until it breaks or,

better, to cut it off with an emasculator. Lambs do better if allowed to run in the pasture. If kept in the sheep house or in a yard, everything should be clean to avoid infection from germs.

DISEASES OF THE EYE.

SIMPLE CONJUNCTIVITIS. SORE EYES.

Causes. Conjunctivitis is due to irritation from various foreign bodies getting into the eye (dust, seeds, pollen, flies, etc.) and injuries of various kinds (blows from a whip, stones, branches of trees, brush, etc.) General diseases, cold winds and wet weather may also cause it.

Symptoms. The eye is held more or less closed, especially if the light is bright. The discharge is at first watery, but soon becomes heavier and more pus like and adheres to the margins of the lids. The conjunctiva is inflamed, thickened, red and swollen. The cornea usually takes part in the inflammation and when it does, it looks white and opaque and the blood-vessels around its margins often become quite prominent. The inflammation may extend to the deeper layers of the eye. Recovery generally takes place in about a week.

Treatment. If any foreign body is present, it should be removed and the eye washed with an antiseptic or astringent lotion. If the lids are wounded, it may be necesary to use hot or cold water applications in order to keep down the inflammation. The following eye lotion can be dropped under the lids with a medicine dropper or applied once or twice daily. Boric acid (thirty grains), sulphate of zinc (fifteen grains), and distilled water (three ounces). Equal parts of boracic acid and calomel by weight may be blown into the eye with an insect powder blower.

ENZOOTIC OPTHALMIA.

Causes. The direct cause of this disease is not known. By most investigators, it is held to be of an infectious nature, but some attribute it to irritating pollen or soil. The disease is spread by diseased sheep coming in contact with healthy ones and in a short time will affect a large number of animals in a neighborhood. Low, damp, land; and level prairies seem to favor the development of the disease. Dust and pollen may act as carriers of the germ.

Symptoms. At first the eyes are closed and there is an abundant secretion of tears. This is followed by a heavy pus like secretion. The

lids are inflamed, red and swollen, the cornea opaque and thickened. Ulcers may form on the cornea and the eye ball become milky white and hard. Usually at the beginning of the disease the body temperature is elevated and there is a partial or complete loss of appetite. When properly treated but few of the sheep go blind and recovery occurs in a short time.

Treatment. It is best to separate the sick from the healthy sheep. The affected sheep should be given cool, dark quarters and the eyes cleaned daily by bathing them with warm water. Following this, calomel and boric acid of equal parts by weight should be blown directly into the eye with a powder blower. If a large number in the flock are affected and suitable quarters cannot be provided, treatment with the powder alone is followed by good results.

ECZEMA.

Eczema, of non-parasitic origin, is not a common disease among sheep, due to the skin being so well protected by the wool and the abundant secretions of the skin. What is commonly known as rain rot may be seen in sheep in poor condition and exposed to heavy cold rains. The rain softens the outer layer of the skin, irritates it and allows the microbes to enter.

Symptoms. The skin is red and inflamed, and vesicles and pimples form. The skin may become covered by scabs and scruf, and the wool shed in places. When the weather improves and the animals are kept under more favorable conditions, recovery takes place spontaneously.

INJURIES FROM GRASS.

A few years ago some sheep were reported to be afflicted with a strange skin disease, supposed to be due to a worm. The symptoms were rubbing, "tagging" of the wool, lack of thrift, and death of a number of sheep. The sheep were from a shipment received from a western state. Upon examination it was found that the skin was badly pricked with the awns or barbs from porcupine grass. (Stipa Spartea.) The awns had broken off in lengths varying from one-eighth to more than an inch in length and left just under the skin.

RHEUMATISM.

Causes. Rheumatism is more common during the late autumn or early spring than at any other season of the year. Sudden changes in temperature, cold, wet weather, untimely shearing, exposure, draughts, etc., seem to favor the development of the disease. Different theories in regard to its cause are advanced by different authors. The muscles, tendons or joints may be affected.

Symptoms. Generally the muscles of the back and loins are affected. It may, however, affect the neck or hind quarters. The gait is stiff and the limbs are carried straight and rigid. When the joints are affected, they become swollen, hot and painful and the disease may shift from one to another. In acute cases the body temperature is higher than normal, the respirations quickened and the appetite lost or impaired. When the disease takes on the acute form the animal becomes emaciated and in a short times dies.

Treatment. The preventive measures consist in keeping the sheep in comfortable, dry quarters, free from draughts. When the rheumatism is localized, local treatment in the form of liniments or blisters can be used. Internally the following can be given: salicylate of soda (one ounce), fluid extract of gentian (one half ounce), and enough water to make eight ounces; mix and give half an ounce in a drench two or three times a day.

FOOT ROT.

Causes. Splinters or other foreign bodies getting into the foot may cause it. It is common in sheep that are moved from hilly into boggy or low land pastures. Filth, decomposing grass, etc., getting into the spaces between the claws will irritate and inflame the feet. The disease may be due to a specific cause and is spread about on the litter, pastures, roads, etc., by matter from the feet of diseased sheep. The contagious foot rot frequently described is not known in this country.

Symptoms. The feet become hot, tender and sore. One or more of the feet may be involved, the animal is lame and frequently it is seen grazing on its knees. The sheep falls away in flesh quite rapidly. If well cared for the loss is not great.

Treatment. In small flocks it is possible to treat each animal separately. In large flocks this is impossible. Foreign bodies in the interdigi-

tal space should be removed and the foot trimmed and washed with about a four or five per cent. watery solution of some of the creolin preparations. In bad cases, a stronger solution can be used. In treating large flocks, a long, shallow tank can be placed at some convenient point and filled to a depth of four or five inches with a strong antiseptic solution. The flock should be driven through this at least once a day and not hurried, but given plenty of time.

INFECTIOUS DISEASES.

ARTHIRITIS OF LAMBS.

Causes. This disease is due to septic substances entering the body by way of the umbilical cord.Filthy quarters and a large umbilical cord that does not dry as soon as ordinary are the predisposing causes.

Symptoms. These are manifested soon after birth. The lamb is feverish, weak, and careless of the teat. One or more of the joints become enlarged, hot and painful. Constipation is frequently present or it may have a diarrhea. Sometimes the lamb is unable to walk or when it does, it is stiff and lame. Pus sometimes forms in the affected joints, and different internal organs. The disease usually proves fatal and if the lamb does recover it is worthless.

Treatment. The preventive treatment consists in washing the umbilical cord soon after birth with about a ten per cent. watery solution of carbolic acid. This will cause it to dry and prevent the entrance of germs. The quarters must be dry and clean, and if the disease is present in a flock, the sheep house must be cleaned and disinfected.

MALIGNANT OEDEMA. BLOOD POISONING.

Causes. Malignant oedema is due to a germ (the bacillus of odema). The germ is present in large numbers in the soil and infection takes place by a wound in the skin becoming contaminated with dirt, faeces, dust, etc.

Symptoms. A swelling forms in the neighborhood of the infected part. This is at first small but spreads gradually in all directions and feels doughy. The center of the swelling is cold, painless and crackles when pressed on. On the margin it is tense, hot and painful. When cut into it has a disagreeable odor. Pus forming germs are present in the

older areas. The general symptoms are loss of appetite, fever, quick, weak pulse, etc. The disease usually terminates fatally in a few days.

Treatment. The treatment is mainly surgical and consists in making a number of incisions into the oedematous swelling and obtaining drainage as well as admitting air. The part must be washed out with a strong creolin solution two or three times a day. If very weak, stimulants can be given.

RABIES. HYDROPHOBIA.

Rabies is an infectious disease and is caused by the sheep being bitten by a rabid dog. It i snot as common a disease of sheep as of cattle, due to their body being so well protected by wool. The period of incubation will vary twenty-five to ninety days.

Symptoms. The expression of the face is usually staring and when approached the animals may become restless, stamp the foot, bleat, etc. If a stick is held in front of them they will frequently bite at it. On account of the bite itching intensely, the sheep may rub and bite the part. The sexual desire is generally increased and the rabid sheep will crowd and push against the other members of the flock, jumping on them and bleating with a dull, rough voice. Weakness soon sets in and in the latter stage of the disease, when startled, it may drop to the ground, lie still for a time and have difficulty in rising. In some cases the sheep acts dull and does not manifest these rabid symptoms. Death takes place in a few days or a week.

When symptoms of rabies are manifested, the sheep should be separated from the rest of the flock or destroyed at once.

VARIOLA. SHEEP POX.

In the early part of the last century, variola was a formidable plague of the flocks of Europe. In 1819 over a million sheep died of this disease in France alone, and in 1823 half a million in Austria. In some European countries it is still prevalent. This disease bears an interesting relation with cow pox in cattle and small pox in man.

Causes. Variola is a highly contagious disease, the contagious element being present in the crusts from the pustules on the skin, in the excretions, blood and expired air. It can be carried a long distance. The exact nature of the virus is not known. In sheep sheds, yards, etc., the virus may remain active for a month or six weeks, but is easily destroyed by putre-

faction, a high temperature and the ordinary disinfectants. Variola is spread by animals that have had it within a period of a few weeks or a month, by innoculated sheep, wool, dogs, manure, fodder, etc. One attack causes a life-time immunity. The period of incubation is from four to seven days.

Symptoms. The sheep is depressed, weak, hangs its head, breathes quickly, is feverish and has chills. In a day or two red spots or pimples appear on the skin not covered or incompletely covered with long wool. When the eruptions are close together the skin becomes badly swollen. In about five days the vesicles or pustules form, dry up and scab over, the swelling then disappears and the scabs loosen and drop off leaving a pit in which no wool afterwards grows.

As a prevention, healthy animals are given a mild form of the disease by innoculating them on the ear, tail, etc., with a virus obtained from a mild case after it has run for six or eight days. The disease does not occur here.

SYMPTOMATIC ANTHRAX. BLACK LEG.

Causes. This is not a common disease of sheep. The specific cause is a germ, a bacillus that when conditions are favorable will probably develop in the soil and live for years. The germ gains entrance to the body by some wound on the leg, mouth or body. The period of incubation is from one to five days.

Symptoms. The tumors may develop on different parts of the body, develop rapidly and are sensitive at first. The skin over the tumor soon becomes gangrenous and cold, and when cut into the tissues are dark colored and a frothy, red liquid together with gas escapes. The general symptoms are loss of appetite, weak pulse, high temperature and finally difficult respiration, violent colic, brain complications, coma, insensibility and death. The disease runs a rapidly fatal course.

Treatment. This is purely preventive. When the disease is present in a flock, vaccination should be practiced.

ANTHRAX.

Anthrax has been known for centuries, but it has been only within the last fifty years that its true character was discovered. In this country the disease is not very prevalent and is not common among sheep.

Causes. The specific cause of this disease is a bacilus, the bacilus of

anthrax. Outside of the body this germ will grow and multiply whenever the conditions are favorable, and it will resist to a remarkable degree, if spores are formed, germicides, dessication, high temperature, low temperature and other unfavorable conditions. It develops best in dark soil rich in organic matter, manure, mud, etc. In anthrax countries the overflowing of river bottoms in the spring or a very hot, dry summer will favor the development of the organism and may cause an outbreak of the disease. The germs are taken into the body with the food or by way of a wound in the skin, tongue or mucuous membrane of the mouth. When a carcass is not properly disposed of flies and other insects act as carriers of the disease and infect healthy animals. It is not uncommon for the carcass of a sheep or other animal that has died from this disease to be dragged over the pasture, road or street and healthy animals may inhale the germs along with the dust, or take them into the body along with the food. Commercial fertilizers, hides, etc., sometimes act as carriers of the disease.

Symptoms. Anthrax in sheep generally takes on a very acute form. The animal is suddenly stricken with apoplexy, staggers, falls down, is seized with convulsions and dies in a few minutes. Black blood is discharged from the anus and mouth. When the disease takes on a less acute form the symptoms will differ. The animal may act restless at first. The respirations and pulse are quickened, the mucuous membranes are dark colored, it frequently tries to pass faeces, is delirious or dull and finally lies down and dies in a short time.

Treatment. This is wholly preventive and consists in destroying the cadaver by burning or burying deeply at some distance from barns, yards or public highways, and vaccinating all susceptible animals. The dead animals must not be dragged over the ground but disposed of as near the place of death as possible. Disinfectants must be freely used around the place where the animal died.

TUBERCULOSIS. CONSUMPTION.

Tuberculosis is an infectious disease and is caused by a specific germ, the bacillus of tuberculosis. This disease is rarely met with in sheep. Infection is said to take place through being kept with tuberculous cattle and in lambs by drinking of the milk from tuberculous cows.

Symptoms. The symptoms will depend on the organs involved and the stage of the disease. In the early stages the symptoms are not sufficiently developed to enable us to make a diagnosis, later it can be easily recognized. The sheep may have a slight cough at first or a chronic indigestion. Glands in different parts of the body may become enlarged. In the last stages, the animal is usually emaciated, the fleece ragged, it stands with the back arched, the respirations are rapid, the lung sounds deadened and it breathes through the mouth.

Treatment. The preventive treatment consists in not exposing the sheep to the disease. When the symptoms are sufficiently developed to enable us to form a diagnosis, the animal should be destroyed and the carcass disposed of in a proper manner.

TETANUS. LOCK JAW.

Causes. This is an infectious disease and is caused by the bacillus of tetanus, a germ that is present in the soil, especially if rich in organic matter. The disease is more common and takes a more acute form in warm than in cold countries. Infection takes place by dirt containing the bacillus entering a wound. Punctured wounds caused by nails or splinters of wood and contused wounds are most suitable for its development. The disease may follow an operation, especially castration, when performed without proper antiseptic precautions. The period of incubation is short, usually less than a week.

Symptoms. In this disease the germ remains at the point of innoculation and there manufactures poisonous substances that have an action on the body similar to strychnine. The symptoms are acute. The sheep stands immovable, with all four legs stretched out as if on stilts, the tail is rigid, neck and back stiff and jaws closed. The muscles of the neck and back are hard, the respirations quick and difficult, the pulse weak, and finally it goes down and dies in a short time. In sheep the death rate is very high.

Treatment. It is important as a preventive measure to treat all wounds properly and to use the necessary antiseptic precautions in performing surgical operations, especially castration. It is only in subacute cases that medicinal treatment is beneficial, and in this disease the administration of medicine is less beneficial than careful nursing. The wound must be cleaned and disinfected, and the sick animal given a quiet,

dark stall and made as comfortable as possible. Plenty of fresh water should be provided and if it can eat, soft, sloppy foods or green grass can be given in preference to dry food. If constipated an enema can be given. Chloral hydrate in half dram doses, every hour in the drinking water or feed may relieve the spasms.

INFLUENZA. MALIGNANT CATARRHAL FEVER.

Influenza is an infectious disease the specific cause of which is not known. It is especially prevalent during certain years and when the conditions are favorable may affect a large number of animals in the flock. As in other diseases, age, breed, care, hygienic conditions, etc., will influence the number of animals affected in a flock. Exposure, draughts, confining the flock in too close quarters and poor ventilation are the common predisposing causes.

Symptoms. The general condition of the sheep is greatly disturbed and the animal presents a droopy, depressed appearance. It is feverish and weak, stands with the back arched and may have a staggering gait. It generally refuses to eat, has a cough and swallows with difficulty. The respiratory mucuous membrane is inflamed, the discharge from the nostrils is increased and sometimes swelling appears under the jaw. Diarrhea is sometimes a prominent symptom. When the respiratory apparatus is generally affected the respirations are difficult and rapid. Pneumonia and inflammation of the brain and its coverings are frequent complications. In some cases both the external and internal parts of the eye become inflamed, the lids are swollen, the conjunctival membrane and the eye take on a milky appearance. The duration of the disease is from a few days to several weeks. In mild cases recovery occurs in a few days, but if not cared for properly a relapse may occur. The prognosis is unfavorable in the severe type.

Lesions. The change in the tissues of the body will vary . In acute cases they are not marked, but when the disease is complicated and the duration a week or more, various tissues and organs are affected. The principal changes are in the respiratory organs. The mucuous membrane lining the pharynx, larynx, trachea, and bronchial tubes is red and thickened; that lining the sinuses of the head is also involved and a portion of the lung tissue may be affected by a catarrhal pneumonia. In severe cases the pleural membrane as well as a large portion of the lung is

affected. Other lesions are in the brain, stomach, intestines, liver, kidneys, spleen, heart and lymph glands.

Treatment. The preventive treatment consists in avoiding conditions that will predispose the flock to the disease. If the disease is present in a flock, it should be looked over carefully every day and the sick sheep separated from the healthy ones and given comfortable quarters, good care and good nourishing food. In mild cases this may be all the treatment necessary. In the catarrhal form the following prescription is useful: tincture of belladonna (four drams), tincture of aconite (one-half dram), and sufficient syrup of squills to make a four ounce mixture; mix and give one tablespoonful three times a day. This treatment is best followed by tonics and expectorants. The following recipe can be given: tincture of gentian (four drams), iodide of potassium (two drams), and enough water to make four ounces; mix and give one tablespoonful twice a day. If diarrhea is present one ounce of linseed oil and a dram of tincture of opium given two or three times a day will give good results.

PARASITIC DISEASES.

GRUB IN THE HEAD. OESTRUS OVIS, Linn.

The parasitis disease of the nostrils of sheep is generally known as grub in the head. The presence of the parasite is not seen from a general examination, only the catarrhal discharge. The grubs are only found on a careful post mortem examination. As a matter of fact, we have very little catarrh of sheep affecting only one side of the nostrils and that usually in late winter and early spring. These supposed catarrhs are nearly always due to the grub stage of the sheep gad fly.

The sheep gad fly is unknown to the sheep breeder in anything except the larval or grub state. The mature fly is like an over-grown house fly of a dullish yellow color so closely covered with small, black spots as to give the whole a brownish appearance. The abdomen consists of five rings, velvety and variegated with brown and straw color. The feet are brown; the wings are transparent and quite large. The head is whitish underneath. There are no mouth parts and the eyes are purplish brown. There are three eyelets on the top of the head. The space between the eyes in the male is very narrow, being less than one-third that of the female. The fly is only obtained by hatching the grub in a cage

and watching developments. They are very sluggish and remain in hiding until fully matured and the temperature is sufficiently high. The female rises high and flies swiftly to a flock and deposits an egg containing a developing larvae. The male never bothers a flock. The female only flies during the hot months and in the middle of the day.

The attack of a flock of sheep by these flies is attended witn the same fright as is seen when the horse gad fly strikes the horses nose. The sheep will push their noses down into the ground between their legs, run,

Section of sheep's head showing grubs in the sinus or cavity above the air passage and in front of the brain.

stamp, snort and huddle together, seek the shade of low sheds, or under buildings. The attack seems to strike terror to them. The sheep are not molested during the morning or evening. As the mature fly has no mouth parts or means of feeding, it is evident that its sole mission is to propagat the species.

The young bot begins to make its way up the nasal passage as soon as it is deposited. This is accomplished by means of the hooks and spines. The operation is attended with some tickling or irritation as there is often violent sneezing and snorting but apparently without avail.

The larvae find their way to the superior part of the nasal cavity, between the turbinate bones, the frontal or facial sinuses, or between the ethemoid cells. Their presence causes some irritation and stimulation of secretion, which it uses as food. It lives in this location for several months, at least over the winter, and make their escape in the spring. Ordinarily we do not find more than one, two, or three grubs in the head of affected sheep. Occasionally eight or ten will be seen. Some writers record from twelve to twenty grubs in bad cases and there are records of from sixty or eighty. When the number is small there are no serious symptoms. When there are several, there is usually marked catarrhal discharge and we have the thick effusive mucous characteristic of the snotty nose.

Treatment. This must be preventive as far as possible. The fly does not attack sheep in the shade and only seeks its prey during the middle of the day. A low temporary shed that will afford shade in the pasture will be a great protection. Valuable breeding stock can well be stabled and allowed to graze during the morning and evening. Some resort to putting tar on the noses every few days to prevent attack. This can be done by smearing the sides of a narrow feed trough so that the sheep can not avoid touching in the attempt to get the grain.

The treatment of a sheep already affected is unsatisfactory. Injecting turpentine into the nostril as so often recommended reaches only a few that may not be in the sinus. Trephining or opening the skull is rather theoretical and not practical on large flocks. Occasional fumigating the stable with turpentine or smoke from tar will palliate the catarrh. If the disease develops in the fall, fatten as fast as possible and dispose to the butcher. If in the spring use good care and feed to carry the sheep along until the grub comes away.

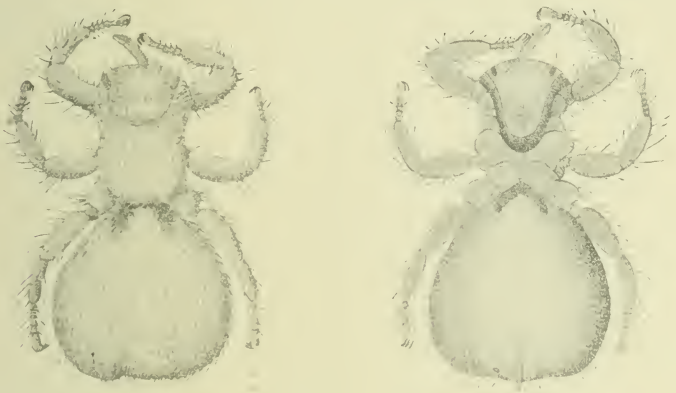
SHEEP TICK.

The sheep tick as it is commonly called is one of the commonest of the parasites affecting sheep. It is not a true tick but a wingless fly.

This parasite is not a native of this country, but has been brought here through importation from Europe. It was first rather confined to the eastern states, but owing to the purchase of breeding stock, and subsequent traffic in sheep, it has been carried to a large percentage of the flocks in this state. The losses occasioned are not from destroying the

sheep by killing, but from the lack of thrift occasioned by their irritating and biting the skin. It is difficult to estimate the losses occasioned in a flock by the presence of this parasite, but where they become numerous there can be no doubt but that it amounts to a considerable sum. The state has been called upon to investigate cases of supposed scab that were due to ticks.

The parasite of this disease, **Melophagus ovius**, Linn, is a wingless fly. It has six well developed legs, a short, flat head set closely upon the



Sheep-tick. Dorsal or back view. Ventral or under surface.

body and a large, oval abdomen. Their resemblance to the tick, with its large abdomen, small head and eight slender legs is not so very close when critically examined.

The full grown tick is about one-fourth of an inch in length and about one-third as wide as long.

The body is short, flattened above and below, very tough and leathery in character. The color varies from an ashen to reddish gray and quite a bright red, dependent upon the quantity of blood imbibed and the time elapsed since the meal. The head is broad and very flat and somewhat sunken into the thorax. The eyes are small and on about a level with the head. The proboscis is tubular and reinforced at the upper part. Its end is armed with teeth. The thorax is nearly square and bears the strong legs. The abdomen is bag like. The legs are each provided with two sharp claws. The legs and body are covered with bris-

tles. There are not wings but a couple of bristle spots take their place.

The sexes may be separated by their size and the form of the sexual apparatus.

The tick being wingless depends wholly upon its ability to crawl for locomotion. It is able to crawl through the wool at quite a lively rate. It bites, and sucks the blood for its food. Formerly it was thought that it lived in part upon the oily matter of the wool and the epidermis of the skin. The fact that the tick soon starves to death even when kept in fresh wool practically settles the matter that it is, almost, if not wholly dependent upon the blood for its nourishment. The bite at the time of its infliction is not painful, but afterward it becomes reddened and itches even more than that inflicted by the mosquito.

The tick does not reproduce rapidly like the sheep scab mite. Only one egg is laid at a time and not more than eight or nine are produced during the lifetime of the female. A number of observers believe that there are only one or two. The egg is large and resembles a seed. It has a hardened case, having a row of seven dots one on each side. The special peculiarity of the egg is the fact that they contain half developed pupae at the time they are deposited. The eggs are laid in the wool and a slight waxy substance secures their adhesion. The insect comes out with fully developed characters. The length of time required for the eggs to hatch is variously given at from three to four weeks. A large number of eggs taken by myself from sheep, and placed in wool at body temperature required from 17 to 22 days to develop.

The tick is a true parasite and can not live off the sheep more than a few days. Not being able to fly they must depend upon crawling to infect new stock, and this necessitates close contact, or the use of very recently used pens. The tick may fall upon the bedding and by chance crawl upon another animal. Their slow rate of multiplication prevents them from becoming very numerous except in the spring of the year. At shearing time from fifty to two hundred may be found on badly affected animals. After shearing, the tick will migrate to the lamb because of lack of protection and under such circumstances may cause considerable loss.

The means of destroying the tick is by dipping, the same as for scab. The dip used for this purpose need not be more than one-third or one-half as strong as that used for scab. The preferable dips are those containing

crude carbolic acid or creolin. The sheep or lamb need not be in the bath more than a few seconds. The sheep become no wetter by continued immersion. Unlike the condition in scab the parasites are all on the outside and readily accessible. Sheep giving evidence of this trouble should be dipped at any time if the weather is favorable. They should be dipped after shearing as the quantity of dip then required is small. It is also a good plan to dip again in the fall. The expense is small, costing only about a fourth or a half cent per head, and in an ordinary tank two hundred can easily be passed through in an hour.

SHEEP SCAB.

Sheep scab is a parasitic disease of sheep, the parasite causing the disease is known as the scab mite or itch mite. The disease is the same as mange or itch in other animals. There are four varieties of scab, common or body scab, caused by **Psoroptes communis**; Furst, variety **ovis**. The head scab is a variety almost wholly confined to the head or where the weel is quite short, and caused by **Sarcoptes scabiei**; de Gier, variety **ovis**. The third variety affects the feet and legs and under parts of the body, is called foot scab and is caused by **Chorioptes communis**; Verheyen; variety **ovis**. The last form affects the eyelids and is produced by **Demodex folliculorm**; variety **ovis**.

All except the first variety are of such rare occurrence as to be of little economic interest. During ten years of experience in the state we have not met or seen a case other than of the first vareity.

While we distinguish these varieties and the affections which they produce are easily recognizable, the life history and habits are so nearly alike that one description will suffice for all.

The common scab mite is very small, being only about a fortieth of an inch in length in the female and one-sixtieth of an inch in breadth. The male is still smaller, being one-fiftieth of an inch in length and one-eightieth of an inch in breadth. The body is oval in shape, slightly rounded above and flat below. It is possessed of eight legs, which are short, the two front pair being quite stout and the last pair is very small. The head is pointed and set close to the body. There are some hairs on the legs and body. The color is a reddish or yellowish gray. These parasites are too small to be recognized by the unaided eye on the body of their

host. Placed upon a dark background in strong sunlight, they may be seen to crawl. The parasite has very feeble powers of locomotion. The scab mite lives by biting the surface skin which, in turn, through the irritation causes an exudate to be thrown out that crusts or scabs. Under these scabs the ovoid eggs are deposited. It only requires two or three days for the eggs to hatch, but about twelve days more for the young to

Female scab mite, Dorsal and ventral views.

undergo its transformation and become an adult. The new parasite then seeks a new area to repeat the process and thus the margin of the original site of infection becomes extended indefinitely. Each female lays about fifteen eggs, two-thirds of which develop females.

Gerlach made a study of the enormous rapidity with which such multiplication takes place and shows that the offspring from a single pair in three months would reach the enormous number of 1,500,000.

His method of computation is as follows:

Generation.	Days.	Females.	Males.
First	15	10	5
Second	30	100	50
Third	45	1000	500
Fourth	60	10000	5000
Fifth	75	100000	50000
Sixth	90	1000000	500000

While it may be that the conditions are never so favorable as to secure complete development of all eggs and some adults become loosened from the body with the wool before reproduction occurs, it does account

for the very rapid development of the disease on a flock, and the enormous number of parasites to be seen in small particles of crusts. It is probable in most instances that only a very few parasites are transferred from a diseased to a healthy animal, and it can be easily understood that slow progress would be made in the first forty-five days and that it might escape attention for the first sixty days after the infection.

It has happened more than once that sheep passing through stock-yards to farms for feeding purposes have apparently been all right for a month or more, and then develop the trouble.

The scab mite is a true parasite, that is one that can not multiply off the animal body and cannot thrive on another host for more than a short

Male scab mite. Dorsal and ventral views.

time. Its life off the body is limited to that of the individual adult parasite, or to well-protected eggs. Just what this period is in each case has not been determined as satisfactorily as it should be. The probabilities are that the period is short and not some months as some assume.

Sheep scab is one of the most annoying diseases that can attack a flock. Attention is not drawn to it, until it has been present for some time and is about ready to make rapid progress. It is destructive of both fleece and animal if not treated promptly and vigorously. It spreads more rapidly during the winter while sheep are penned and the fleece is long. The disease is one of so much importance that it is made the subject of special legislation in many of the states and by systematic efforts may be stamped out.

Sheep scab as it occurs in this state is due almost wholly to the

bringing in of sheep for feeding purposes. The recent investigations of about 5,000 cases reported has shown that more than nine-tenths were sheep that had been in the stock yards or shipped on board cars. The yards and cars may be considered permanently infected and the single dipping given at the yards will not suffice. The disease if present is only checked and after a couple of months of feeding in warm stables begins to show itself. It is a serious question whether it would not be advisable to prevent the bringing in of all sheep except on permit.

The act of the legislature approved March 6, 1901, provides that sheep scab shall be reported to the State Veterinarian—being a contagious disease—and provides specifically as follows:

Sec. 4. That all sheep consigned to or passing through stockyards shall be dipped before leaving, if intended for any other purposes than immediate slaughter in the State, the time of dipping, the manner of dipping, and kind of dip used to be subject to the approval of the State Veterinarian: Provided, That in the winter and at such times as the dipping of sheep would be hazardous to their health, the sheep may be withdrawn upon permit from the State Veterinarian, which permit shall be issued upon the written agreement of the owner that the sheep will remain in his possession, and that he will dip at such future time and in such manner as the State Veterinarian may direct. That all sheep found affected with scabies shall be dipped at such time and in such manner and with such dip, as the State Veterinarian shall direct, and at the expense of the owner.

Symptoms. The effect of the scab mite is one of irritation to the skin. Whether this is due wholly to the biting in the effort to obtain food, or whether some part is due to some poisonous substance secreted and innoculated with the bite is not known. The very intense itching, papules, and inflammation with the attending exudate would seem to indicate that it is due to something more than mere mechanical injury.

The itching causes the sheep to scratch and rub and bite and this is aggravated by the heat. A sheep with a long, heavy fleece in a warm stable will show this irritation much more than one shorn and in the open field. The wool will loosen at the points of attack and by rubbing and biting is pulled out, first in small bunches, and then in large masses giving the fleece a very rough or ragged appearance. In advanced stages these

patches run together and leave the body almost bare. The effect of biting is to cause an inflammation of the skkin and an exudate which forms a crust or scab. It is under this crust or scab that the eggs are deposited, and when the new generation is brought forth, they migrate a short distance and repeat the biting process and thus increase the area. The disease is distinctly one of progression requiring a month or more from the time of infection to develop symptoms that will attract attention, sixty days more to develop a well-marked case, and ninety days or more to render much of the animal bare. The disease does not tend to self-recovery, but to destruction unless vigorously treated. Aside from causing loss of life it causes loss of fleece, loss of flesh, and breeding ewes may loose their lambs.

Treatment. The treatment of sheep scab consists in using some application which, when brought in contact with the parasite or eggs, will kill them. Sanitary measures are essential, but as the disease is not caused by unsanitary surroundings alone, sanitary surroundings alone will not prevent or cure. No internal medication is efficatious. Of the external applications, the dips alone are worth considering. Ointments or dips for hand application are only advisable where one or two sheep are affected; where a few are affected, and the weather is too cold to dip, or for temporarily arresting the disease in ewes in an advanced stage of pregnancy. All local applications applied by hand may be put down as only palliative. It is a rare thing that they are so well applied that they cure. The application of scab or lice powders are likewise lacking in efficiency, and the use of any of these means only means the postponing of the date when general infection of the flock will occur unless separation has taken place at the same time. The essentials of a good dip are that it should kill the parasite and should cause little or no harm to the sheep, the fleece, or the operator. The combination of all these qualities is not easily attained, otherwise there would not be as many formulae or so many discarded dips. There have been bulletins published giving numerous formulae for the preparation of dips, but the basis of about all have been lime, sulphur, tobacco and arsenic. These have been used in varying proportions and in combination, sometimes in such manner as to be quite harmful and at other times almost harmless. The whole question of dips was carefully investigated by the Bureau of Animal Industry, and the

conclusion reached that probably the most effective dips were those composed of sulphur and tobacco, and sulphur and lime of known quantities, and of such strength that they were not injurious to the sheep or fleece. The composition of the sulphur and tobacco, and lime and sulphur dip, and the manner of preparing can be followed by any intelligent stock owner. The objections to tobacco and sulphur dips, and lime and sulphur dips arise from classing all the dips composed of these materials as being the same while as a matter of fact there is widest latitude in their composition and method of prepartion. In some formulae the lime and sulphur are present in equal proportions, in some, the lime is in excess at the rate of two to one, and in others the sulphur is in excess at the rate of of three to one. The quantity of lime and sulphur present may vary from thirty pounds to the hundred gallons of dip to two hundred and fifty pounds per hundred gallons of dip. The very strong dips are dangerous to the life of the sheep and injurious to the wool. The dips containing the least lime and sulphur have been found to be effective and produce no noticable effect upon the wool. The Colorado dip consists of thirty-three pounds of flowers of sulphur, eleven pounds of unslaked lime, and one hundred gallons of water, and is regarded as very effective. The Bureau of Animal Industry dip consists of the same proportions, but in still less quantity, twenty-four pounds of flower of sulphur, eight pounds of unslaked lime, and one hundred gallons of water. The objections urged against lime and sulphur dips based upon the injuries or damages done by the very strong dip cannot be applied to these.

To make a lime and sulphur dip requires more time and care than is usually given to make a proper mixture. The lime and sulphur should be weighed and the exact quantity of water measured. The given quantities of lime and sulphur are taken and water added until it can be rubbed into a creamy paste. This mass is now boiled in from twenty-five to thirty gallons of water for two and one-half to three hours and stirred occasionally during the boiling period. The mixture is now allowed to stand over night in a barrel, or other receptacle, so that all the solid matter may settle and the clear liquid may be drawn off. It is important that only the clear liquid should be used. The clear liquid is then diluted in the dipping tank with sufficient warm warm water to make one hundred gallons and is ready for use. On the basis of first cost of

material the lime and sulphur dip is very economical, but where only a few sheep are to be dipped, the trouble attending its preparation is so great that it is doubtful whether it is the most economical to use.

The tobacco dip may be made as follows. Take sixteen pounds of tobacco leaves or stems and cover with warm water and let stand for a day. The amount of water used should not be less than thirty gallons, and it is preferable that it should be the full quantity to be used, one hundred gallons, if the receptacle is large enough to hold it. At the end of a day, bring the tobacco infusion to the boiling point for a few minutes and allow it to stand over night. Strain off the infusion. Take as many pounds of flower of sulphur as tobacco used, mix the sulphur in sufficient water to make a smooth, creamy mass. When ready to dip warm the infusion to one hundred degrees, and if only thirty gallons of water has been used, dilute to one hundred gallons and add the sulphur and keep it well stirred during the dipping.

The tobacco and sulphur dip is the most effective that has been used in this state, but is tedious and disagreeable to make and while we have no desire to advertise any particular dip, we believe that few can afford to make the dip under ordinary farm conditions, so long as good tobacco extracts may be purchased in the open market. The first cost of materials for the tobacco infusion would be less than for the extract, but if a man's time is worth anything, or he is affected by the disagreeable odor from the tobacco in preparation, the extract from the leaves is to be prefered.

There are a number of good proprietary dips upon the market, and in the state, the practice is to allow the owner to select his own dip as long as the results desired are accomplished. Where advice is given, however, it is to use tobacco extract with sulphur. For ticks the creolin-like preparations are preferable but cannot be relied upon for scab . An arsenical dip may be made as follows: arsenic, two pounds, sulphur four pounds, and carbonate of soda, two pounds for each one hundred gallons of water. The soda and arsenic are first dissolved in a couple gallons of water and then the flower of sulphur added and stirred vigorously for a few minutes until it makes a smooth paste. This is then kept ready and added to the required amount of water at time of dipping. The arsenical dip is not any more effective than the tobacco dip and is not so good because of being poisonous and accidents are likely to follow. The sheep

must be kept off all pasture until thoroughly dry so that the dripping may not fall upon that which may be eaten. Every particle of dip not used should be buried to insure that no stock shall find access to it. Arsenical dips were used very extensively but so many accidents have resulted that they cannot be recommended except in such cases where great care will be exercised.

All dips should be used fresh. It is bad practice to dip a flock of sheep and allow the residue to remain in the vat for ten days or until the next dipping. The failures and alleged injurious poisonous effects may often be traced to such practice.

The quantity of dip required will depend upon the number of sheep to be dipped, the length of the fleece and the extent to which the drainage returns to the vat. It requires several gallons of dip in which to immerse a sheep so that the loss is large when only a few sheep are to be dipped. In general it may be said that after shearing, and until the wool becomes about an inch in length that each sheep will carry off from a quart to a quart and a half of dip after it has been allowed to stand for a few minutes. In the latter part of winter and before shearing, the loss will be nearly one gallon per head. These amounts may seem large, but are about the average as found in practice.

Arrangements for Dipping. Sheep may be dipped with very simple arrangements, a box just large enough to hold a sheep and dip and a few square feet of drain board on which to place the sheep for a short time will suffice. Effective dipping may be done in this manner, but with much labor and loss of time. Such a method is probably justifiable where there are only a few sheep that must be dipped in an emergency. If a large number of sheep are to be dipped or dipping is to be done every year, it will be found more economical to build or buy a dipping tank as it will be more convenient, and save dip and labor. The dipping tank should be narrow at the bottom, wide at the top, straight up and down at the end where the sheep are expected to enter, and the bottom built on an incline at the other end so that the sheep may walk out and not rquire to be lifted out.

The incline is one of the most important features of the tank as it is desirable that the lifting of the hundred to one hundred and fifty pounds of soaking sheep be avoided. The dipping tank should be located at some

convenient point for corralling the sheep, as a barn floor, or along the side of a fence and a hurdle erected to drive the sheep to the end of the tank. The tank should be partially sunk into the ground to make it convenient for the operator and to avoid the necessity of getting the sheep up so high. A draining floor must be provided about five by ten feet, water tight and so placed and inclined that the excess dip will return to the tank. Where small flocks of fifty to three hundred are to be dipped,

A simple arrangement for dipping sheep.

we have found nothing so quickly made to serve this purpose as a good wagon bed. If it leaks it can be made perfectly tight with linoleum at little expense. The accompanying picture will show a convenient arrangement that may be obtained on any farm with probably the minimum trouble and expense.

INTERNAL PARASITES

THE BLADDER WORMS.

Taenia marginata; Batsch.

On dressing sheep and lambs it happens sometimes that the folds of the omentum or caul will contain a number of semi-transparent bladder like bodies from a half to one inch in diameter. A similar condition may be found on the brain due to another variety of the parasite. These bladders contain a worm known as the bladder worm and are one stage in the development of the tape worm.

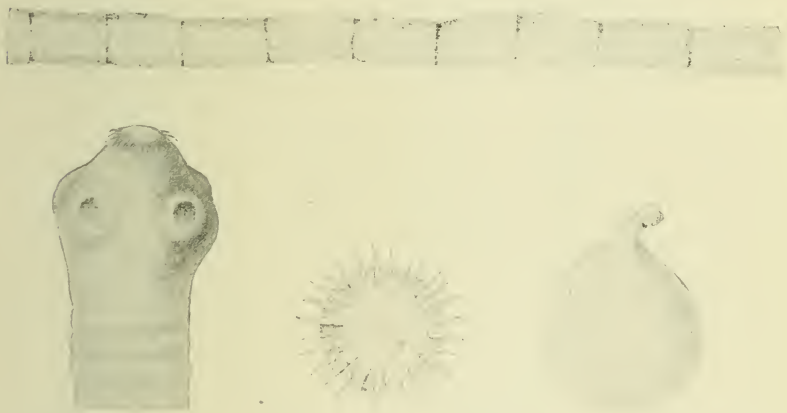
The Taenia marginata; Batsch, is the variety affecting the abdominal cavity. In from one to two weeks after sheep ingest the eggs of this parasite, the young will have developed and migrated from the intestinal canal and a favorite place for them is on the surface of the liver. They may migrate from any part of the intestinal tract and therefore may be found at any place along its course. The bladders are composed of a delicate, whitish membrane and when viewed toward the light, one point will appear to be denser than the rest. As these bladders grow this spot becomes thicker and denser. This is the head and the part by which it is attached to the cyst wall. This head is fully developed with hooks and suckers, and when freed becomes the starting point for the development of the mature state in some other animal. The parasite requires about two weeks from the time of the ingestion of the eggs to develop and migrate through the intestinal wall. It requires about eight weeks more to develop into mature cysts, but when matured as cysts they may remain in this condition for a long period of time. This is as far as the parasite ever develops in the sheep. To complete its life cycle the sheep, when it is killed or dies, must be eaten by a dog, wolf or other carnivorous animal, the cyst is ruptured and the head attaches itself to the intestinal wall and begins to develop into the form known as the tape worm. The tape worm becomes fully developed in from ten to twelve weeks, and the young worms in the form of eggs, and the segments are discharged with the faeces. These embryos fall upon pasture and are taken up by grazing sheep to run another life cycle.

The bladder worms are likely to cause peritonitis when migrating in large numbers from the intestine or liver. The bladder worms that come

to the surface of the liver either result in destroying their host or die after a couple weeks, the location not being favorable for development. Those finding their way into the folds of the omentum seem to cause little inconvenience. The sheep may become infected at any time of the year, preferably during the grazing season, but may from eating hay containing the excreta of dogs. The young sheep are susceptible, but those past five or six years possess a resistance that protects them even against intentional feeding.

The diagnosis of the trouble in sheep is difficult to make except by post mortem. There have been severe losses attributable to this disease, but it is of less importance in this state than in many others.

The Treatment must be wholly preventive. When once the cysts have been formed there is no remedy that can reach them. In the dog the tape



The bladder worm. The mature segments as found in the dog. The head. The hooklets. The bladder as found in the sheep.

worm may be expelled by suitable remedies. The sheep husbandman must therefore treat the dog, keep off all dogs, and burn or bury carcases of affected sheep so that dogs will not have access to them. Areca nut powdered, two grains for each pound of body weight, or ethereal extract of male shield-fern are suitable remedies for causing their expulsion from the dog.

THE BLADDER WORM OF THE BRAIN.

Taenia coenurus, Kuch.

The bladder worms found on the brains of sheep resemble those found in the abdominal cavity except that they are smaller. They are about the size of hazel-nuts, have a fairly tough membrane and translucent when held up to the light. The bladder worm of the brain is the cystic state of a different species of tapeworm from that affecting the abdomen. In this

The mature bladder worm of the brain.

case the eggs are taken in with the food and as soon as the embryos are freed, they begin to migrate. They enter the circulation and are carried by the blood current to various parts of the body, but those lodging at any point execpt in the brain or spinal cord die, the same as those that find way to the surface of the liver in **Taenia marginata**.

When the embryos, find lodgment in the brain they begin to channel their way to the surface and in doing so may make any kind of track

straight or crooked. On arriving at the surface the cyst or bladder is formed. On being examined toward strong light, instead of one dense, white body on the inside a dozen or more may be seen. On opening these all appear as heads, in this respect differing from the bladder worms found in the abdomen. The number of these little heads reach into the hundreds.

The adult stage of this worm is found in the dog, wolf, fox and some other carnivorous animals. The eggs are passed with faeces and thus find their way upon pasture where they may be taken up in the grazing. The egg covering is dissolved and the embryo freed. It begins its migration at once as already described. It remains in the cyst stage until the sheep is killed or dies and can only cause trouble again if the brain is eaten by some animal as already mentioned. The multiplication of heads in the cyst stage seems to be a final effort to maintain the species as the possibilities of a mature worm ever being developed must be only one for several million eggs voided, only one possibility out of many that of those ingested one will reach the brain, and a still smaller number would ever be devoured with the carcass as the brain would be best protected.

The disease caused by the bladder worm is known as gid, turn sick, or staggers. There are two stages when the symptoms are presented, first when the embryo is migrating to the surface. The injury caused at this time is that of a character to be accompanied by inflammation. The symptoms usually develop within a couple of weeks after the infection. The sheep are dull, stupid, hot, and most often the head is turned backward. The position in which it is held will depend in part on the seat of the inflammation. It may be extended, or cramped to one side. If lying down the head is usually forced backward, the movements force the animal back, and there will be spasm and convulsions. There is redness of the eyes. Death results within a week. In the second stage the symptoms are due to pressure of the cyst. The head turns, the sheep walk in a circle and this gives it the name of gid or turnsick. It acts stupid, trembles, staggers and has convulsions, refuses to eat or drink and dies. Only a few recover when once the symptoms are well developed.

There is no treatment for the trouble that is practical. It may be prevented by destroying all heads of sheep that die, or by treating the dogs as indicated for the Taenia marginata.

FRINGED TAPE WORM.

Thysanoscma actinioides, Diesing.

The fringed tapeworm is a very common parasite of western sheep, by some considered to produce more trouble than any other parasite with the exception of the scab mite. It is found in greater or less number in the majority of flocks in Colorado, Utah, New Mexico, Nebraska and adjoining territory. The parasite is not of much consequence in this state, except as it is brought in with feeding stock. Whole car loads of sheep brought from St. Louis and Chicago have suffered from the affection, and as high as sixty per cent. have died. In some few cases, the disease has been communicated to the home-grown sheep; but, as a rule, recognition of trouble has been so early or the flock kept intact until re-shipped so that little spreading has occurred. The losses from the fringed tapeworm are not due directly to the active ravages of the worm, but to the secondary effects, as lessened growth of wool, poor flesh, and inability to stand cold weather. This variety of tapeworm is slow growing, requiring perhaps seven or eight months to mature. They are usually present in considerable numbers and have attained large size before the symptoms attract attention.

Description

Thysanosoma actinioides, Dies. Strobila 15-30 cm. long; head large, nearly square when viewed en face, 1-1.5 mm. broad, placed like a "T" on the neck. Suckers very large, prominent; openings large, elongated or oval, at the four corners, and directed forward or half forward. Neck is exceedingly flat, dorso-ventrally, and quite broad. Segmentation begins almost immediately back of the head. The broadest segments measure 5-8 mm. wide by 0.4-0.6 mm. long, and are situated about 2 cm. from the posterior end. The posterior segments show a decided tendency to become longer and narrower. Mature segments attain a thickness of 2.2 mm. The posterior flap of the segment is broken up into fimbriae, which in the end segments attain the length of the segment itself. There are present in each segment two lateral genital pores, two ovaries, two vitellogene glands, but only one uterus. The latter is situated in the anterior portion of the median field, is composed of a small canal with numerous blind sacs, and surrounded by thick, fibrous tissue. The genital canals pass from the median field between the dorsal and ventral canals, and

dorsally of the nerve. The dorsal canals are somewhat smaller than the ventral canals, and connected by transverse segmented canals.*

The fimbriate tapeworm is from six to eighteen inches in length and found almost wholly in the gall ducts and front part of the small intestine. The worm has been found a half inch in length in lambs two months old, but not in the adult in lambs under ten months. The adult stage is usually found in yearlings and two-year-olds. The gorwth is very slow, being at the rate of only about one inch per month, and after they have attained full size, it is usually sometime before they mature.

This tapeworm grows as do the other varieties, by continuous segmentation at the head. Each segment is complete in itself. Each contains two sets of sexual organs, male and female that show a lateral opening or pore. The reproduction is hermaproditic: The male organs are developed first, when the segment is still near the head. The ovaries develop later and the uteri last. The development is complete when the segments are about half the length of the worm from the head. The eggs develop an embryo which is held in the uteri. As the segments ripen, they break loose and are discharged with the faeces. What becomes of the worm from the time the eggs are discharged until it is found as a worm a half inch in length in some sheep is not known. It is certain that the eggs do not have to pass a larval stage in some one of the higher animals. It is not so certain that they may not have an intermediary stage in some of the lower forms. In some experiments by Curtice, of infection by feeding on a dry lot, it would seem that the infection might be direct. Experiments by feeding the ripe segments were not positive so the life history of the inter stage, is still undermined.

The worms when present in sheep as a rule show every stage of development indicating that infection may extend over nearly the whole year. Occasionally all will be of nearly the same size indicating short period of exposure. The symptoms do not usually develope until late in the fall or winter when the number and bulk have attained such proportions or mass as to interfere with the biliary secretion and digestion. The symptoms are lack of nourishment, undersize; hide bound, large

*C. W. Stiles. A Revision of the Adult Cestodes of Cattle, Sheep, and Allied Animals. Bureau of Animal Industry: pp. 58. Washington; 1893.

head, digestive disturbance due to intestinal irritation and obstructed bile, grinding the teeth, lagging behind the flock, unusual attention to supposed harm, as dogs and strangers, foolish actions and sometimes slovenly gait. These symptoms may all be accounted for by the lack of nourishment, and impoverished blood.

The Treatment of the fringed tapeworm is not very satisfactory. Medicinal agents become much diluted before reaching the small intestine and none can be made to reach those in the bile duct. A remedy that is recommended is a solution of copper sulphate commonly known as blue stone. One pound (av.) of clean bluestone crystals is dissolved in two quarts of boiling water, and when dissolution is complete, seven and four-fifths gallons are added. The dose of this solution is about two thirds of an ounce for lambs one months old, one and one-third ounces for lambs two months old, two ounces for lambs three months old two and two-thirds ounces for lambs four months old, three ounces for lambs five months old and older. Care must be used in measuring the parts in mixing up the preparation and in getting the size of the dose. Copper sulphate is quite poisonous and must be handled with care.*

The sheep are prepared for dosing by keeping them off feed and water for fifteen or eighteen hours and holding them off for a few hours after ward. The medicine is best administered by means of a long necked rubber syringe and discharging the amount well back in the mouth. Care must be used lest some of it be inhaled and cause pneumonia.

The writer has not had personal experience in dosing such affected sheep and the recent report upon the subject by the Bureau of Animal Industry is rather negative.

THE BROAD TAPEWORM.

Moniezia expansa; Rud.

The broad tapeworm is the variety that more nearly fills the popular conception of what a tapeworm should be. It is a long worm of twelve to fifteen feet and a half to three quarters of an inch in breadth. It is of only ocasional occurrence, however, and as far as known not the cause of any serious losses in this state.

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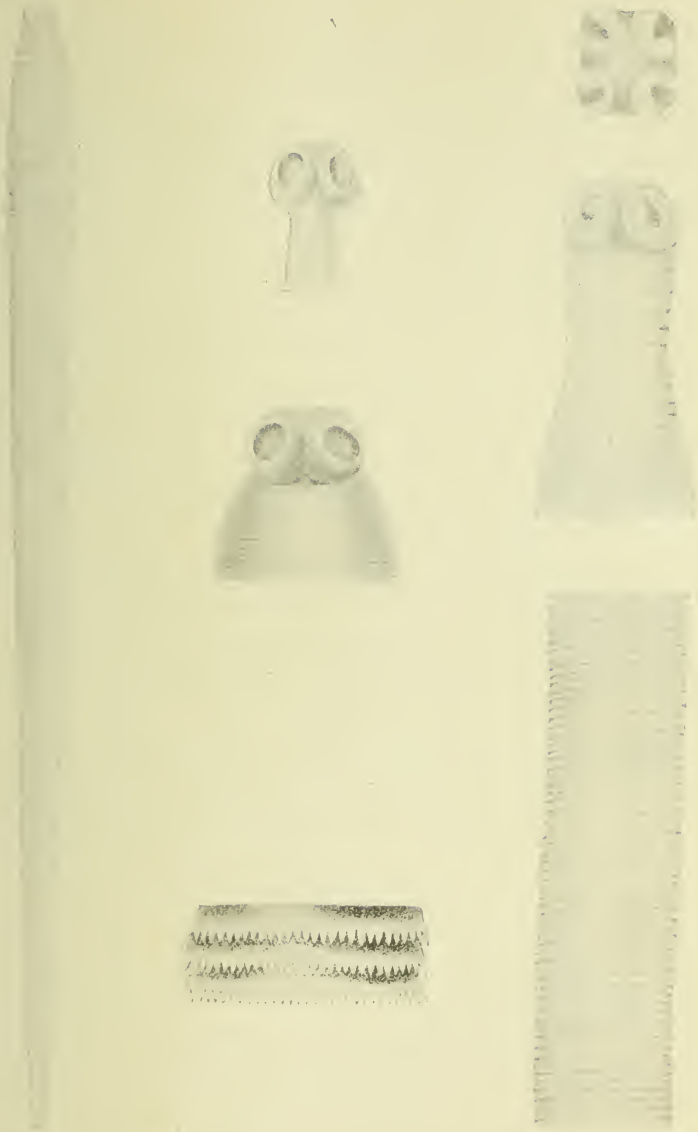
*C. W. Stiles. The Inspection of Meats for Animal Parasites. Bureau of Animal Industry. Pp. 133: Washington, 1898.



Fringed tape worm. Adult natural size. Edge and side views of the head. Enlarged mature segment.
Broad tape worm. End and side views of the head and a few segments.

Description.

Moniezia expansa R. (1810). Strobila attains 4-5 m. in length; anterior portion usually whitish, posterior portion generally yellowish. Head 0.36-0.7 mm. in diameter, obtuse, more or less square, slightly lobed; suckers distinctly raised, apertures directed diagonally forward. Segments always much broader than long; and segments attain 16 mm. in width and are quite thick. Topography of nerves, longitudinal canals, genital canals, and female glands similar to M. planissima: (pores double situated in in the anterior portion of the lateral margin, vagina and cirrus on the same transverse plane on the right, vagina ventral, cirrus dorsal; left side; vagina dorsal, cirrus ventral; genital canals pass dorsally of the longitudinal canals and nerves;) testicles usually arranged in a quadrangle, rarely in two triangles except in the younger segments. Interproglottidal glands localized around blind sacs which open between segments. Ova 50-60 μ bulb of pyriform apparatus 20 μ *

The complete life history of this tapeworm is not known: what becomes of the worm from the time the ripe segments pass out of the body with the faeces and what changes it undergoes until it infects some other sheep have not been determined. The presumption is that the eggs freed from the broken down segments are eaten by some insect, snail, worm, or other low form of animal, that the tapeworm passes through the cystic stage and later these insects, worms or whatever they may be are swallowed by the sheep while feeding and the cyst set free in the intestinal tract. It is certain that in the case there is an intermediary host, that it is some low form of life. Sheep kept shut up in stables have been found to become affected but only rarely so. In fection usually occurs upon pasture. Experiments made to infect sheep by direct feeding, of ripe segments have not been successful. They have become infected when fed the segments and eggs in high, dry lots, but in all cases there was opportunity for infection. The fact that this tapeworm is found rather rarely in winter and spring while the sheep are upon dry feed, and in stall-fed sheep, and that it is most often found in late summer and fall, shows that natural infection is associated with the grazing.

*C. W. Stiles. A Revision of the Adult Cestodes of Cattle, Sheep, and Allied Animals. Bureau of Animal Industry, pp. 34. 1893.

The tapeworm disease affects lambs and young sheep more often than the older. The young seem to be especially susceptible and the old to have a natural resistance. The growth of the worm is very rapid, as adults have been found in lambs three months old. After attaining the full growth they remain some time before shedding their segments. In the case of this species practically the whole body is shed at about the same time leaving only the head and three or four inches of the neck. When these begni to grow the sheep may have attained such an age as to resist the inroads, and the heads be eventually expelled. The number of worms present may vary from one to more than a hundred, but it is not usual to find more than a dozen.

The Symptoms are those of lack of nourishment. The sheep are usually infected for some time before attention is directed to them. They become thin in flesh, the wool is white and without yolk, lips and eyes pale, flanks tucked up, the appetite is likely to be depraved and the sheep eat large quantities or unusual articles. It frequently happens too that there is diarrhea. The sheep are not strong, lag behind the balance of the flock, and are easily affected by cold. The whole appearance is that of absolute loss of blood. A postive diagnosis cannot be made without seeing the segments of the worms in the faeces or by holding a post-mortem.

The sheep begin to improve as soon as the worms shed their segments.

The medicinal treatment is not very satisfactory. Many preparations have been used and recommended, but the more learned about them by direct experiments, the less effective they seem to be.

LIVER FLUKE.

Fasciola hepatica; Linn.

The liver fluke is of very rare occurrence in this state. As far as known to the writer only six flocks have been affected in the past ten years and in these the infection was brought onto them from the south-west. There is no fear of permanent infection of our pasture.

The liver fluke is a broad flat worm found in the liver of sheep, goats and cattle. It is described as follows:

Description.

Fasciola hepatica, L. Body; pale brown, leaf like, flattened, 18-15 mm.

long by 4-13 mm. broad. The anterior 3-4 mm. forms a rather thick, conical portion which is followed by a large flat, leaf-like body of elongate, oval form this latter widens rapidly to the maximum breadth, and then decreases, gradually in width to the posterior end which is bluntly pointed; cuticle is covered with numerous spines placed side by side in alternating rows; oral sucker is anterior, round and terminal, but inclines ventral; acetabulum about 3-4 mm. caudad of oral sucker, with which it closely agrees in size; genital pore median, about half way between oral

Liver fluke.*

sucker and acetabulum; oesophagus rarely over 1-1-½ times as long as the pharynx; intestine dentritic; cirrus frequently extended from pore and then recurved; testicles profusely branched, situated for the greater part posterior to transverse vitello-duct. Vulva is at side of cirrus; uterus forms a rosette with its numerous coils, and is frequently visible to the naked eye as a dark-brown spot, immediately posterior to the acetabelum; ovary branched, anterior of transverse vitello duct; vitellogene glands profusely branched, and occupy the entire margin of the body from acetabulum to posterior extremity; they lie dorsally as well as ventrally of the intestine, becoming wider posterially. Oviparous.

*From Bulletin No. 18. Texas Experiment Station.

Eggs; oval, 0.13-0.14 mm. long by 0.075 to 0.09 mm. broad; miracidium conical, ciliated with oval papillae, two cup shaped eye spots, rudimentary intestine; metamorphosis (sporo cyst, redia, cercariae) take place in small snails of the genius Linneae; L., trucatula, and others.) Cercaria whitish, owing to excessive development of capsule glands; encysts upon plants.*

The life history of the liver fluke is one of great interest. The eggs are produced in immense numbers and pass through the gall duct to the intestine and out with the faeces. Those that fall in favorable places as puddles of water escape from the shell. They are very delicate, covered with hair to aid in swimming and have a proboscis to puncture the body of a variety of small snails. It is necessary that it should find a snail in a day or two otherwise it will die. If it should find a snail it punctures the body to the respiratory tract, and becomes encysted. It is here known as the sporocyst and may divide into several bodies, five to eight and these are develop into rediae. The rediae are about one-twelfth of an inch long. These raediae are liberated from the sac and these in turn develop within themselves from fifteen to twenty bodies known as cercariae and it is these latter that escape from the suail. The cercariae after some slight change become encrysted on grass or wherever it may happen to be. In this stage will resist drying, temperature changes, etc., and is the form in which it is swallowed by the sheep. The swallowed cyst has the shell digested by the action of the gastric juice and the young soon finds its way to the liver where it becomes an adult and the process is repeated. By some form of migration the flukes may find their way into lungs. The eggs seem to be passed through a period of a month or more during the summer, the first development of the offspring takes place in the summer and the cyst comes on later in the fall.

The Symptoms of fluke disease are not all recognized by the stockman. There is a period of migration from the intestine to the liver lasting during the summer that is attended by little disturbance. During the late fall and winter the affected sheep show a lack of thrift, disinclination to eat heartily; a paleness about the eyes and lips, yellow tinge in the skin;

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*Stiles, Ch. Wardell and Hassell, Albert—

Journal of Comparative Medicine and Veterinary Archives, XV. pp. 302, 1894.

there may be fullness between the jaws, the wool is dry, brittle and easily pulled. The third stage follows the second and not easily separated from it. The animal looses flesh rapidly, becomes emaciated, the appetite keeps up but the most marked character is the wasting. The fourth stage is that of natural migration of the parasite late in the spring, and spontaneous recovery. The sheep as a rule die in the second or third stage if badly infected.

No remedies are servicable in this disease.

THE TWISTED STOMACH WORM.

Strongylus contortus, Rud.

The stomach worm, or twisted stomach worm, **Strongylus contortus**, Rud., is a very common parasite of sheep. From an economical standpoint, it is the most important of all the parasites in this state. It has caused the death of as many as 85,000 sheep in a single year in this state. Probably the average annual loss that may be attributed to this cause will be about 30,000 head. The parasite is to be found in greater or less numbers in nearly all flocks, but it is only when they occur in large numbers or occur in connection with some other disease that they cause great loss. Lambs are particularly liable to the affection, those having passed the suckling age and older sheep are better able to withstand the attack.

The Strongylus contortus is a small thread-like worm. The female is from one-half to about one inch in length and the male from three eights to one-half inch in length. The males are thicker in proportion to their length than the females. The bodies vary from a reddish brown to white depending upon the fullness of the intestine with blood, which has been abstracted from the stomach wall. The bodies are pointed, more at the tail than at the head. The mouth is located slightly behind the fore end and is marked by two small eminences. The female is made conspicuous by two white spiral tubes extending nearly the whole length of the body which are the uteri. They appear so promiently because of the contrast with the intestinal contents . It is these that give the parasite the name rather than the shape of he body as a whole.

The parasite is easily recognizable in the stomach of a recently killed sheep, but are easily digested by the stomach fluids and therefore

Twisted stomach worms. Adult female. Adult male. The head showing the barb. Small worms are natural size.

frequently escape observation if a post-mortem be made late. In the recent case the worm will be found closely attached to the mucous membrane. In a post-mortem deferred for some time the worms will be loose in the stomach contents, of a greyer color and so much resemble the fibers of plants that to the untrained eye they may escape observation, even when hundreds are present. The worm may be found in very stage in the fourth stomach. They are found in greater numbers in the summer and early fall than at other seasons of the year.

The life history of this parasite seems to be quite simple. The eggs contain a young embryo when deposited, and pass through the intestines and fall upon the pasture with the excrement. If they be kept moist or find their way into stagnant water they undergo such transformations as are necessary outside the body. The extent of these changes is not well known. The worm may then be taken up by some other sheep while eating or drinking the surface water. The amount of moisture retained on grass after rains or dews is sufficient to sustain them if the grass be able to shade the ground. The young are killed by drying which accounts for the lessened disease on high ground and in dry seasons. It is believed that it is necessary that the eggs pass out of the body and undergo some change and that they cannot hatch and mature in the stomach of the same animal in which they were deposited. Such being the case it would seem that the disease is communicated only through feeding upon infected pastures or drinking surface water that had become foul through excrement. The reason that lambs are more seriously affected than old sheep is probably due in part to a milk diet with their feed and to a more tender condition of the stomach wall.

The Symptoms of the presence of stomach worms are not distinctive; that is, taken as individual cases an absolute diagnosis could not be made. The affected sheep show lack of thrift, inclination to move slowly, they are stiff in one or more legs, the back is arched and to spend considerable time in the shade. The appetite is poor or they will eat unusual objects. The thirst is increased, there is often grinding of the teeth, and black diarrhea. Examined closely the mucous membrane of the eyes and the lips are pale. These are the symptoms in the typical case and as a rule it runs a course of several days or a few weeks. In the acute cases these symptoms are greatly aggravated and death re-

sults in a few days. In very acute forms death may result from inflammation of the stomach as a result of a sudden attack of the parasites upon that organ. I have seen a few cases in which the affected animal exhibited no recognizable symptom in the morning and be found dead in the field at noon. In addition to these symptoms the history of several animals being affected will often have much weight in deciding the diagnosis. A post-mortem upon a recent case will give an absolute diagnosis.

Treatment. This must be divided into preventive and curative measures. As a preventive measure we take advantage of the fact that the eggs fall upon the grass, and that they will be killed by drying. When the disease is suspected or known to exist in a flock, we can alternate the use of pasture fields every third day in very wet seasons, avoid the use of low pastures or too short pastures, at any time; to give a part dry feed ration or hay in order to increase the hard woody stomach content and later in the summer to pasture a part of the time in the corn field. Where the flocks are small and it is feasible to do so, I find that this latter is a particularly good practice, and has given excellent results. The weeds and such grass as may be present in the corn will not be infected and the droppings will fall upon bare ground so that no infection can take place. Here sheep will do little damage to the corn.

The medicinal treatment is a nuisance to administer and unsatisfactory in results. It requires the administration of the medicine to each individual and repeatedly. The worms being located in the fourth stomach can not be reached by the medicinal agent until it becomes so much diluted that its efficiency is greatly reduced.

A vermifuge powder may be made as follows:

Areca nut, powdered, one-half pound.
Worm seed, powdered, one-half pound.
Gentian, powdered, one-fourth pound.
Sulphur, powdered, one-fourth pound.
Sulphate of iron, powdered, one-fourth pound.

Mix thoroughly and give with meal or crushed grain at the rate of an ounce to ten or a dozen lambs, or six old sheep. This should be done in the morning after the sheep have been kept up in a lot over night and it is well to hold them from pasture for a couple of hours after its administration. The dose should be repeated about every third evening for a

couple of weeks. In flocks not too badly infected or where it was almost necessary that some preparation should be used with the food, I have found the foregoing to be the best of a large number tried. Diseases requiring vigorous treatment, I add two ounces santonine to the above amount.

There have been a very large number of remedies proposed for the treatment of stomach worms, but in practice there have been, but few found to be efficacious. One of the most largely used agents is an emulsion of turpentine in milk or oil. An emulsion of an ounce of turpentine to a pint of milk freshly prepared and from two to four ounces administered depending upon the size of the lamb. The emulsion with oil is made by adding one ounce of turpentine to two ounces of raw linseed oil and giving from one-half to one ounce of the mixture. The emulsion with either milk or oil should be freshly prepared and well shaken up prior to drawing off the dose.

Gasoline is a newer remedy recommended for use. Each dose must be mixed separately in linseed oil or milk, and the quantity to be used is a teaspoonful of gasoline for the lamb or a tablespoonful for the sheep, in an ounce of the oil or two ounces of milk. This treatment has been most highly recommended by some investigators and many sheep-men in the past few years. Our personal experience has not been with such favorable results.

In the giving of turpentine or gasoline the sheep should be kept in an enclosure away from feed over night and the dose administered in the morning and no food allowed for a couple of hours afterward. The dose can best be administered with a syringe having a soft rubber tube that can be passed well back into the mouth. The sheep should be held in the standing position and the head should not be held up as it increases the danger of the fluid passing into the lungs. For a complete treatment these remedies will need to be repeated each day for three days. One treatment often gives such good results that the repetition is not made.

The latest treatment of which much has been said is coal tar creosote. This is administered as a one per cent solution in water, the dose being about two ounces for a lamb. This has given us better results with a single treatment than any other.

INTESTINAL WORMS.

Strongylus ventricosus, Rud.

This species is found associated with Strongylus filicollis in the upper part of the small intestine. It is generally found in the fall of the year. It is very small and so far as known, of little consequence.

Description Male, 6 mm.; female, 13 mm. Body very small and comparatively stout. Males and young females usually spirally coiled; body of old female straight, with cephalic end coiled; skin transversely striate, marked by fourteen longitudinal lines; the larger standing at equal interspaces on the dorsal and ventral surfaces, the two smaller standing close together on the sides. The crossings of the striae and longitudinal lines make pits which are quite characteristic. Head little larger than neck, but hemispherical and continuous with the cylindrical inflation of the neck. No head or neck papillae visible. Mouth terminal, very small and round. The end of the head is furnished with a spherical cap-shaped chitinous piece. Other oral armature apparently absent. Inflated portion of head about one-fifth the length of oseophagus. Unicellar glands not apparent. Male about one-half the length of female; bursa conical and bilobed, the ventral membrane being narrow, the dorsal wide; ventral costae not separate; smaller than the ventro-lateral which is stout; lateral widely separate and apparently formed of three nearly equal costae; dorso-lateral slender; dorsal notched at the end and giving off laterally a very short side branch. Spicula 0.36 mm. long, short and stout, and margined by a fringe-bearing sinuous membrane. They are tipped by a soft pad-like expansion of the membrane. Female characterized by a swelling at the vulva which gives the species its name. This character is more pronounced in older specimens. Vulva from two-ninths to one-third of the entire length of the female from the tail. Uteri directed anteriorly and posterioraly from the vagina. Ova 0.13 mm. long, 0.07 mm. wide, comparatively large, and found in all stages of segmentation, embryo not observed.

Strongylus filicollis, Rud.

This is one of the very small worms affecting the intestine of lambs and sheep. Taken by itself it probably does little harm. It may be found in consideraable numbers in the fall. It is so delicate that it would escape observation from the ordinary observer.

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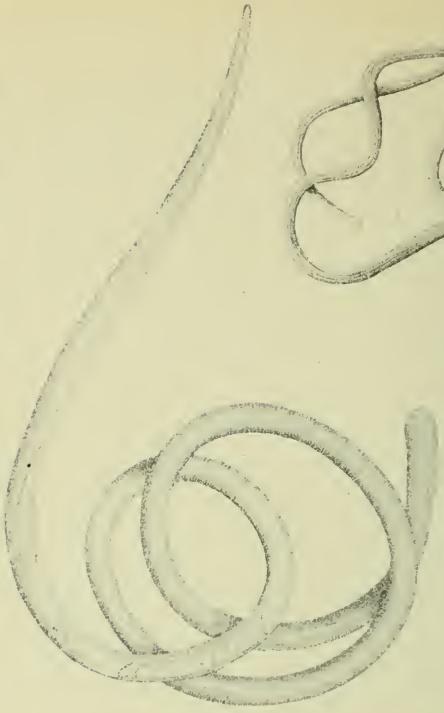

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Strongylus filicollis. 1. Male. 2. Female. 3. Head.
4. Bursa. Strongylus vertricosus. 5. Male. 6. Female

Description. Male, 8 to 15 mm.; female, 16 to 24 mm. Body very small; cephalic end, thread like and tortuous; caudal end, especially of female, thick and straight. Skin marked by longitudinal lines standing at about equal distances apart. Head very small, subspherical, continuous, with a swollen cylindrical neck; the length of the inflated portion is about one-fourth that of the oesophagus. Four head papillae visible; the lateral papillae are probably present but can not be easily made out. Mouth terminal; apparently without chitinous armature. Oesophagus linear spatulate; unicellar gland ducts present. Position of ventral cleft not determined.

Male; filiform and uniform in size throughout its length; bursa strongly biloped; the membrane being well filled on the dorsum but absent on the ventrum; cannot be spread without tearing; costae generally symmetrically arranged, ventral slightly separated; ventro-lateral either joined to lateral or ventral; lateral scarcely separated; dorso-lateral joined to the dorsal, dorsal notched and with the dorso-lateral form a stem, the two pairs uniting to form the dorsal stem; the lateral costae are the longest. Spicula 1.5 mm. long cylindrical, very slender and dark colored; their points are tipped with an oval inflation of the membrane and are more or less firmly attached.

Female: Tail obtuse; vulva situated about one-third of the entire length of the worm from the tail; body of the egg-bearing female enlarged in front of the vulva by the swollen and crowded uterus. Uteri directed each way from the vagina, and filled with comparatively few and large eggs in all stages of segmentation. Eggs, 0.17 mm. long, 0.08 mm. wide, ovoid; laid in the morula or gastrula stages. Embryo not observed.

Dochmius cernuus, Creplin.

This is a rather stout parasite of the small intestine and may be mistaken for the twisted stomach worm by those not accustomed to examining for parasites. It is fairly stout and is found attached to the mucous wall, as it feeds upon the blood. This worm is rarely found in large numbers, otherwise it might become a serious parasite. It probably causes more losses now than is attributed to it.

Description Female, 20 to 26 mm.; male 13 to 17 mm. Body very dark colored when fresh; whitened when preserved; attenuate towards the ends. Head curved, the mouth being directed dorsally. Mouth round,

smaller than the oral surface and opens into an ovoid dark-colored capsule About the opening stand four teeth, two on each side, their base being sunk into the capsule and their free edges projecting into the cavity. The ventral are the larger, thicker and more opaque; their edges form an unbroken sinuous line. At the caudal opening of the capsule are one pair of ventral and a single dorsal tooth; the latter is conical, very large, and rises to near the mouth. In the pharyngeal opening are six very small club-shaped, spinuous, chitinous appendages of the oesophageal supports or rods; they seem to be jointed. There are six papillae, dorsal, lateral, and ventral pairs. The lateral may give off a branch on the dorsal side. There are two lateral neck papillae, nearly opposite the middle of the oesophagus; the ventral cleft is situated a little anterior to a line connecting the latter. Unicellar neck glands quite plain.

Male: Bursa funnel-shaped; will not spread without tearing; costae unsymmetrical as to form; ventral pair not separated; lateral widely separated; dorsal; notched; dorso-lateral unequal in length and differently attached to the dorsal stem. Spicula 0.6 mm. long, aculeate, fenestrated, and provided with a narrow membranous margin.

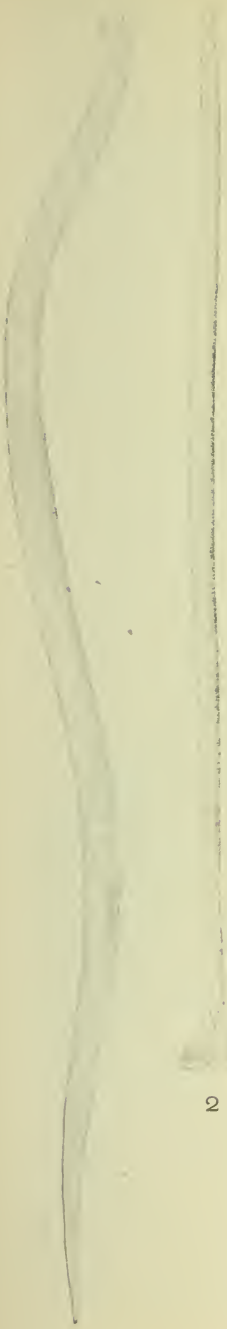
Female: Vulva about three-fifths of entire length of the body from the end of the tail. Vagina opening at right angles to the side of the body. Uteri, lying one anterior, the other posterior; each forms an S-like loop; the anterior ovary is directed towards the tail, and with the posterior forms an intricate sinuous net work surrounding the intestine. Eggs elliptical; laid in the morula stage; length 0.06 mm.; width 0.03 mm.

THE NODULAR DISEASE.

Oesophagostoma Columbianum, Cur.

During the winter and early spring many sheep, particularly breeding ewes die, and on post-mortem show a large number of nodules on the intestines. These nodules are most abundant at the upper end of the large intestine, but may be found at any place between the stomach and rectum. These nodules are often taken to be tubercular, as they contain a yellowish or greenish cheesy matter. This peculiar disease has not been known for very many years and seems to be gaining its foothold quite rapidly.

The nodular disease is caused by a very small intestinal worm. The worm is very small, from only one-eighth to one-sixth of an inch in



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Dochmius cernuus. 1. Female. 2. Male.
Œsophagostoma Columbianum. 3. Male. 4. Head
5. Bursa. 6. Cyst.

Nodular disease of the intestines.

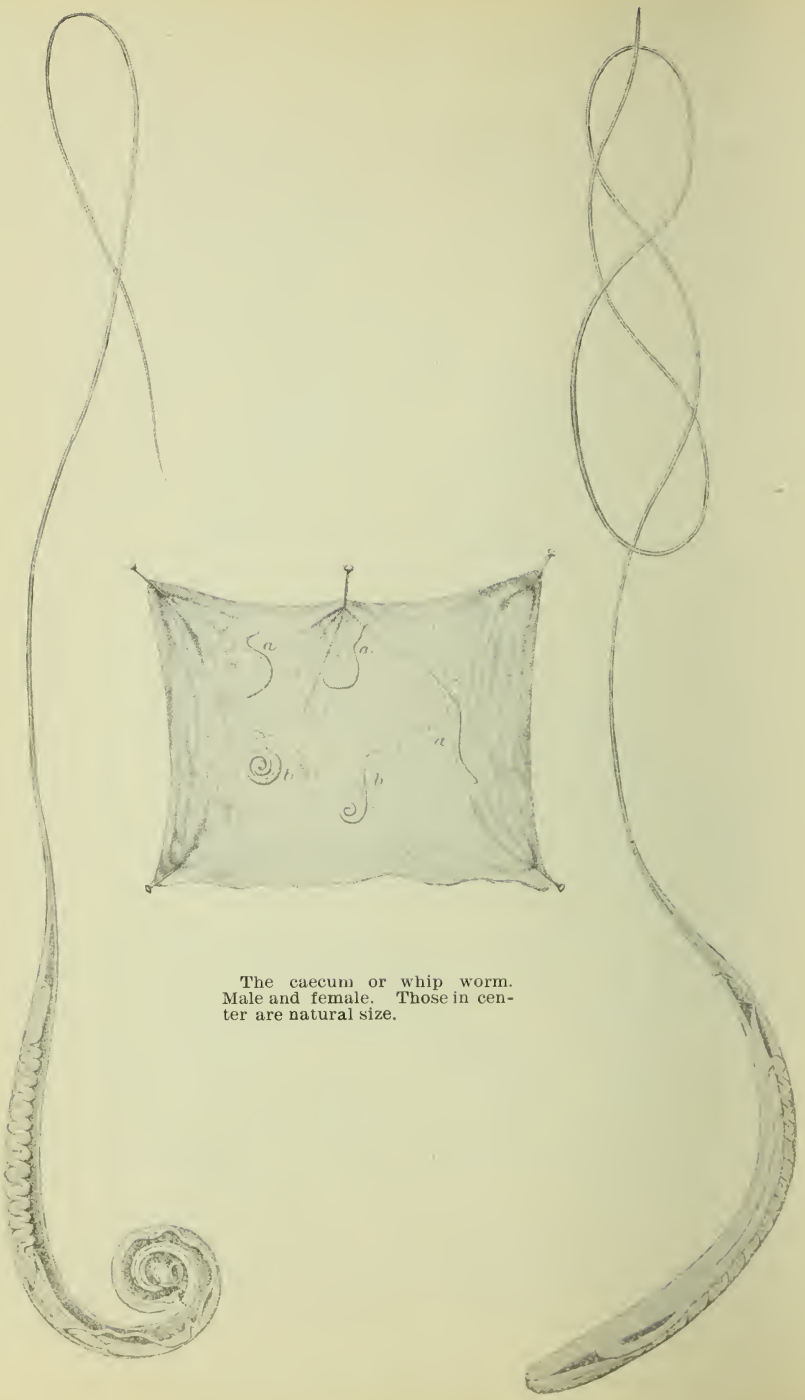
length. They inhabit the front part of the large intestine in particular, but when present in very large numbers they lodge in almost any place. The eggs are laid and passed out of the intestine with the faeces to fall upon the pasture and infect another through the food or drink. It appears as though some of the eggs may be matured in the intestine and the young pass into the intestinal wall and develop very slowly. This occurs mostly in the latter part of summer or fall, and these young require the whole of the winter to make their change. It is apparently a method of slow development provided by nature to insure the carrying of the species from one season to the next. All classes of sheep may be more or less affected but apparently old sheep suffer more than lambs. The loss is observed more especially in breeding ewes because the general nutrition is interfered with at or about lambing time. The extra nutrition required due to advanced gestation is too great and death results.

While the worm remains in the intestinal tract it passes unnoticed owing to its very small size and if it produces any harm at that time it has not been recognized. When the young pass into the intestinal wall, they become encysted and are marked by small whitish spots. Their presence causes irritation and a local inflammation with debris deposit. This gradually increases and the very small cyst develops into a nodule the size of a millet seed to that of a grain of corn. The older the cyst the harder will be the content in that part while in the vicinity of the worm the content is softer. The parasite lives on this debris. While the sheep have grass or succulent food these nodules remain fairly soft and interference with nutrition is not great. When the sheep receive hay, straw, fodder and grain the contents of these nodules become dryer and often calcareous and they may add some obstruction to the bowel as well as otherwise interfere with nutrition. When the worm emerges from the nodule to the intestine the irritation stops and the content is absorbed.

THE CAECUM WORM.

Trichoceohalus affinis, Rud.

On opening the caecum of sheep at slaughter houses or upon post-mortem, there is nearly always to be found a few whip-like worms from one and one-half to two and a quarter inches long. The body or handle portion is only one-fourth to one-third the total length and the remainder



The caecum or whip worm. Male and female. Those in center are natural size.

is very delicate. This worm is to be found in small numbers in nearly all sheep during the summer and fall, but oftener can not be found in late winter and spring. In the ordinary numbers it causes no trouble so far as known, but possibly does when present in the large numbers sometimes seen.

Description.

The parasite is described as follows. Male and female about equal, 40 to 70 mm. long. Body whip-like possessing a short, stout, caudal end, 12 to 18 mm. long, and a very thin hair-like cephalic end of twice this length. The latter contains the oesophagus and intestine; the former the reproductive organs and intestine.

The head is very small and thin, without noticable papillae or chitinous armature. It is said to sometimes have two vesicular, transparent, wing-like inflations. Skin of the neck transversely striate, and when highly magnified shows a serration of the sides indicating cuticular layers which overlap each other like shingles on a roof. Oesophagus and cephalic portion of intestines very minute; its posterior end is large and dark, and empties at the caudal end of the body. On one side of the head there appears to be a canal filled with granules.

The male is to be distinguished by its highly curled caudal end. The testicle, beginning near the caudal end, continues anteriorly as a sinuous tube for about two-thirds the length of the thick portion of the worm; it then becomes plaited to the end of the thick part, where it turns and continues posteriorly as an enlarged seminal duct for about half the length of the thickened body, where it is constricted; the remainder continues to the cloaca as a slightly enlarged tube. The intromittent apparatus consists of two parts, an external membranous tube bristling with spines and an internal long, slim spiculum. It is always found exserted, and usually has one coil in it. The tube shows at its end that the external covering continues around the end into the tube to form a lining membrane, which may be retracted or protruded. There is considerable space between these membranes at the tip, and it assumes various forms varying between a large sphere, (as shown in the figures) and an elongate cylindrical body. The chitinous spiculum is terminated by an acute point. It is from 5 to 6 mm. long, with a width of 0.025 mm. The tube is about three or four times as wide. The spiny points are turned away from the end.

The female has a thick body, and only slightly curved. Tail, obtuse, ovary begins at the caudal end, continues as a plaited canal to the cephalic end of the thick part of the body, then contracting returns to the caudal end where it enlarges, forms a fold and becomes the uterus, which empties through a sinuous vagina and the vulva at the cephalic end, where the body begins to enlarge. Eggs characterized by having refrangent polar bodies at each end. They measure 0.077 mm. in length, including these bodies, or 0.056 mm. excluding them (Raillet). They are elliptical and dark brown.

The eggs are passed with the faeces and develop on damp ground where they will continue to live for sometime. The experimnts with tnis parasite are nearly enough complete to show with scarcely any doubt that the embryos may be taken directly into the stomach with the food and that no intermediate host is required.

HAIR LUNG WORM.

The hair lung worm is the smaller of the two varieties of worms affecting the lungs. It is the one that inhabits the smaller air cells and the disease caused by it is a pneumonia, as distinguished from the large lung worm affecting tne broncni and causing a bronchitis or hacking cough.

Description.

Male, 16 mm.; female, 25 mm.; width, 0.5 mm.; female 1.7 mm. Capillary integument of worm very transparent, the cavity of the body appearing as a dark line. Head not winged; four papillae; mouth naked. Male, bursa pointed, compressed, terminal, costae (apparently) seven; one posterior, twice notched two pair lateral, one pair anterior; spicula symmetrical, spatulate, curved; 0.15 mm. long, divided into two nearly equal parts; the anterior consisting of a cylindrical chitinous skeleton with a membranous expansion, the posterior of a transversely ribbed skeleton, margined by a thin, broad, curved membrane, the two spicula forming a partially closed tube. Female oviparous, with two uteri and ovaries. The former empty into a vagina at 0.8 mm. from vulva. Vulva 0.1 mm. from anus. Anus 0.8 from tip of tail. Tail ends in a blunt point. Eggs in uteri 0.1 mm. long, 0.04 mm. wide. The eggs segment after being laid. Embryo provided with snarp pointed tail.

This lung worm is so small that it escapes the attention of the flock master, and farmer. What he finds upon post-mortem is solidified lung

as in pneumonia. The disease is generally referred to as pneumonia, and it is only when a competent observer is employed or that the history of a number of cases is presented, do we get a diagnosis of the parasitic character. I feel quite certain that the disease is of much more frequent occurrence in this state than is at all suspected.

The complete life history of the worm remains to be determined. The young escape from the lungs during acts of coughing, but what becomes of them from that time until they are again found in the lung has not been determined. It is surmised that they undergo such changes as may be necessary on the pasture or in water and after a short time are again taken into another animal while grazing or with the drink. Whether they find an intemediate host in some insect or low form of animal life is not known. Some observers reasoning from analogy consider that such is a part of the life cycle. Other observers do not consider such to be a necessary part of the life cycle. The disease is only on certain pastures—pastures that have become infected through bringing in some diseased sheep. The disease spreads throughout a flock to greater extent on very wet years than in years of drought. A fairly low pasture used continuously throughout the season is also bad.

Whether the embryos are swallowed and migration takes place from the stomach to the lungs, or whether the parasite enters by ways of the trachea is also an undetermined matter. In some parasites such migration does take place, but these parasites have never been found between the stomach and lungs. It would seem, too, that it would be a difficult matter for the worms to become disassociated from the food in the throat while the animal was in the act of swallowing and make its way down the trachea. How long a period of time is necessary for the parasite outside the body and how long inside to complete a life cycle are also points that have not been determined. Its ill effects are most marked upon old sheep seemingly indicating that it requires considerable time.

This parasite penetrates the air passages to its most minute branching. It causes irritation and inflammation of the wall of the air passage and cells and a general breaking down of the tissue. As in all inflammatory processes nature attempts its arrest of extension by walling it off. Each worm then becomes the center of a slight inflammatory area that is walled off and resembles a tubercle. The contents of the inside are broken down and galatinous, outside the capsule is firm and fibrous. These tubercles are about a twentieth of an inch in diameter at first, but in the later stages become about an eight of an inch in diameter. The parasite is always found in the central part surrounded by greenish or yellowish material, thin and pus-like, or may be dry and cheesy. They may become calcareous by lime deposition. These tubercles undergo quite a series of changes from that of a simple blood spot under the pleura to that of a

hard grey nodule. When the worm matures it migrates to the bronchia to mate and lay eggs, and these hatch and the young being very active set up an inflammation. If it is severe we have the pneumonia that sickens or kills the sheep. The pneumonic areas are small, limited to the point of parasitic involvement and resembles the ordinary catarrhal form. With the exudate numerous worms and eggs are thrown off in the act of coughing. The fact that the worms are present in every stage of development and tubercles show every condition from the hemorrhage to dry caseous and calcareous infiltration indicates that multiplication may take place in the lungs as well as from infection from without.

The diagnosis can not be made until the disease has progressed to the point of producing pneumonia and a post-mortem is made. The prognocis will depend upon the extent of parasitic invasion. No medicinal treatment can be given that will secure the expulsion of the worm.

As a preventive precaution, pastures where the disease has been known to occur should be abandoned for at least a year. It is desirable htat the sheep be pastured upon land that has been under continuous cultivation as that tends to destroy any parasites that may be present.

THE THREAD LUNG WORM.

Stongylus filara, Rud.

This is the larger lung worm and is the one generally referred to by most observers in reporting lung worm disease. It may be seen on opening the trachea and bronchi and is identical with that found in calves. Curtice regards this as of being of less frequent occurrence than the hair worm and that it often occurs that the lesions found due to the hair worm are erroneously ascribed to this one.

Description.

Male, 33 to 54 mm.; female, 55-80 mm. Worm filiform, white, with a dark hair line, showing throughout its length; head obtuse, without noticable papillae or wings; mouth circular, naked; unicellar neck, glands quite large; cuticle longitudinally striated. Male, bursa shallow, campanulate, opening laterally; five sets of costae; the dorsal are trifid, the lateral bifid and the ventral separated. Spicula arcuate cylindrical; 3.35 mm. long by 0.075 mm. wide; short, very thick, dark brown; chitinous portion a curved fenestrated conical tube; fleshy portion a membrane, which forms a bulb-like expansion toward its free end. Female, vulva three sevenths of her length from the head; uteri symmetrically directed anteriorly and posteriorally; posterior oviduct becoming continuous with the uterus near its flexure at the tail; ovo-viviparous; eggs ellipsoid, 0.075 to 0.120 mm. long; 0.045 to 0.082 mm. wide. Embryo 0.25 to 3 mm.

The complete life cycle of this worm is not fully determined. The eggs, or rather the embryos, are expelled by the act of coughing and distributed upon the pasture, the feed, water trough and whatever may be near. How much time is necessary to be spent outside the body and whether they must pass any part of their existence in some lower animal is not known. Professor Leucart has kept the young of this species alive for several weeks on damp earth and observed them to molt and then die. They have been kept alive for several months in water. This latter statement may account for the persistence of the infection in some cases. How the parasite finds its way into the lungs, too, after being taken into the mouth with the food or water is not clearly demonstrated. The worm develops quite rapidly in the bronchi and is found to effect principally lambs and young sheep, thus differing from the hair lung worm. The symptoms of lung worm are those due to the irritation of the bronchial tubes. The bronchitis differs in no respect from a bronchitis associated with a cold. There are accumulations of mucous, sometimes of a bloody character, sometimes a cough and expulsion of this mucous. In some cases the cough is the prominent symptoms and in that way gets the name of "hoose." With it may be difficulty in berathing. The general health is impaired. The appetite may remain good, but what is eaten does not seem to do much good. The wool becomes dry and harsh, without yolk, slips easily the skin is thin and tender giving the name of paper skin. There is paleness of the mucous membranes of the eyes and lips. The animals are thin and become exhausted easily either from exercise or exposure. The course extends over a period of three or four months.

The disease is most noticeable in summer, fall and early winter, begins to wane during the middle of winter and practically disap-

pears in the spring. A damp season favors the development of the worms. When the symptoms develop early there is little chance for recovery, but when they develop late, the chances of recovery are good. When recovery takes place the lamb will always remain dwarfed and there will be loss of flesh and fleece.

As in the case of the hair worm, where the disease develops on a pasture, the same should be abandoned for a year and in its stead fields used that have been in crops. The use of surface water should be avoided.

Medicinal treatment promises more in the case of this parasite than in that of the hair lung worm. These parasites lying free in the bronchial tube may be reached to a limited extent. Internal medicants that may be eliminated through the lungs, inhalation and intra-tracheal medication have all been recommeded. After reviewing a considerable literature upon the subject, it appears that few remedies are better than turpentine. This may be given both internally and by inhalation. If given internally, about a dram may be administered with a little milk or oil to make an emulsion. If given as an inhalation, a couple of ounces may be placed on the surface of a bucket, or kettle of hot water and allowed to diffuse in a small, close stable. Or equally as good, a quantity poured on some hot bricks. Either method will require repetition. Good food and tonic will also be necessary to maintain the general body condition.

ACKNOWLEDGEMENT.

The cuts of parasites and the scientific descriptions where not otherwise credited, are from the United States Bureau of Animal Industry report upon "Parasitic Diseases of Sheep" by Cooper Curtice; Washington, 1890.

The data relative to the frequency of occurrence of the different affections in this state has been made possible through the office of State Veternarian.

Purdue University

Agricultural Experiment Station

BULLETIN NO. 95. VOL. XII.
MARCH, 1903.

Unproductive Black Soils.

Published by the Station:
LAFAYETTE, INDIANA,
U. S. A.

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THE IMPROVEMENT OF UNPRODUCTIVE BLACK SOILS.

By H. A. Huston.

OCCURENCE.

In nearly every county in central and northern Indiana may be found a kind of black soil, often known as "bogus land." It is also sometimes called "alkali," but not correctly, for the land has none of the real characteristics of alkali soil.

The size of the areas of unproductive black lands varies from a few square rods to a hundred or more acres. Many of the places where it is found were formerly marshes or the bottoms of old ponds. Such land is found at all elevations above the level of the water courses from bottom lands beside the streams to the summit of the ridges or divides between the water courses.

GENERAL CHARACTER OF THE LAND.

The unproductive soil itself consists of partially decomposed organic matter mixed with more or less sand and clay. In the large areas the organic matter makes up the greater part of the material and the soil has the general character of muck lands. In some of the smaller areas there is more mineral matter present. Often these small areas are low places in fields of clay or loam and differ from the remainder of the field only in having more black matter in the soil, and being at a lower level. On digging down in these small areas it is generally found that the distance to the hard pan, clay or gravel, is much greater in the "bogus" places than in the good soil near the border of the bogus place, indicating that at one time the "bogus" place was filled with water to a considerable depth and gradually became filled up with the washings from the higher land surrounding it and with the products of the decay of the water plants growing in it.

In the larger areas the stratification and general characteristics of muck beds are found, the muck being from a few inches to fifteen feet in depth.

I have collected numerous samples of such soil and have received many samples from different parts of the State. In no case has a sample shown any acid reaction nor have I found metallic sulphides or ferrous iron compounds present. The waters of such soils have always given the slightly alkaline reaction common to the waters of this section.

As none of the causes usually assigned as the reason of unproductiveness in soil were present, it was determined to investigate this class of land more fully. A chemical examination for the three plant food compounds most frequently deficient in agricultural soils showed that from a chemical standpoint the soil was abnormally rich in nitrogen and contained much more phosphoric acid than the fertile loams of the State.

The total potash is only about one-fifteenth of the potash found in average soils of the State. Yet the fact that complete analyses of both soil and subsoil of the productive and unproductive land from the same field showed practically the same potash content, and in fact the same content of all ingredients, led one to believe that, while potash might be exceedingly low in these soils, there was probably some additional difficulty to be overcome. The unproductive soil seemed to be quite low in sulfur and experiments bearing on the use of sulphates on such soils are now in progress.

The amount of humus* in all the soils was so high as to lead to the belief that there was an abundance of available nitrogen.

The air dry sample of soil and sub-soil contained:

	Soil.	Sub-soil.
Water	16.32	16.23
Ash	39.94	42.87
Nitrogen	3.22	2.84
Phosphoric Acid, $P_2 O_5$	0.46	0.27
Potash, $K_2 O$	0.105	0.108

Attention was next directed to the question of drainage. For this purpose unproductive lands in White, Carroll, Tippecanoe and Clinton counties were examined. With the exception of the tract in White County, which was drained by a system of deep, open ditches, these lands "had been thoroughly tiled and the tile had been laid by an expert." The examination showed that the tile had been laid through these lands at the usual depth and at intervals of 150 feet between the laterals. There was no obstruction of the tile found. The White county tract belonging to Mr. Samuel Virden, and the tract belonging to Mr. John McCoy were selected for further investigation. The Virden farm is a portion of the prairie through which Honey Creek runs. The creek has been straightened and dredged out to a sufficent depth to afford a large outlet for drainage water. On this farm the "bogus" soil occurs in small areas not exceeding an acre in extent. The field on the McCoy farm consists of

*Determined by Huston modification of Grandeau method. Bul. 46. Vol. IV. Indiana Ex. Sta.; Chem. Div. Dep't of Agri., Bul. 38, p. 84; Wiley, Agr. Chem. Anal., p. 326.

about twenty acres lying between the bottom land of Wea Creek and the higher lands to the east. One half of this field has produced about 70 bushels of corn per acre continuously for nineteen years, while the unproductive portion has produced practically nothing. In wet years, perhaps, two or three bushels per acre might be obtained. The tile is laid 3½ to 4 feet deep and laterals are 150 feet apart. (Laterals are 4 inch tile). The sketch, fig. 1, will show the arrangement of the tile and the boundaries of the field.

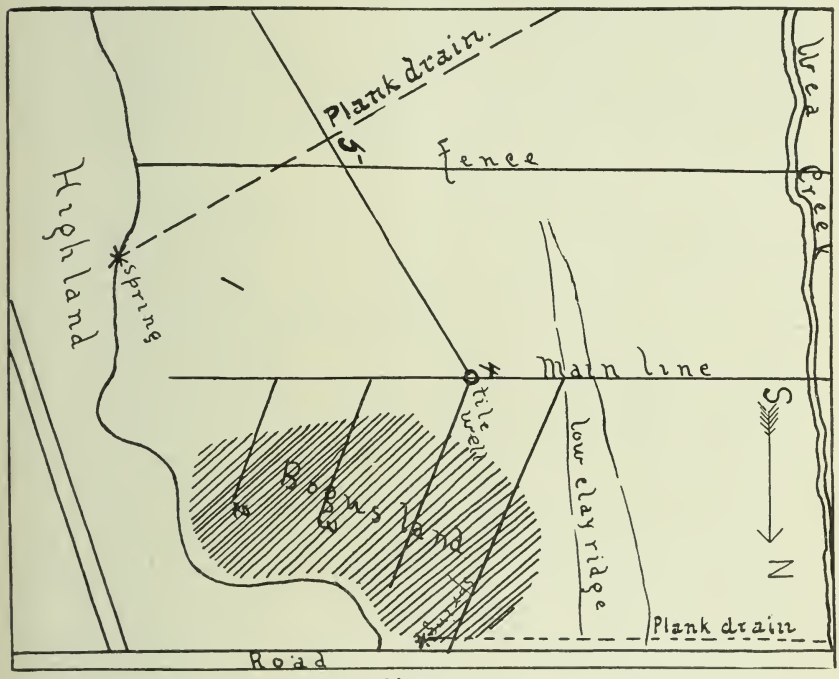


FIG. 1.

The soil is of muck from 1½ to 5 feet deep. The muck is underlaid by a mixture of shell marl and muck. Below this is a layer of fine white sand which rests on a very thin layer of clay. Under this clay is a layer of gravel carrying a strong flow of water. The shaded area in fig. 1 shows the location of the bogus land. Four lines of 4-inch tile, laid 3½ feet deep, extend through the unproductive land. At the point 4, fig. 1, a tile well is introduced in which the flow from the upper half of the main tile and that from two of the laterals may be observed. The lateral to the south of the main tile at about the point 5 runs through the water bearing grav-

el for a short distance. The flow of water from this tile is always greater than that from the main tile and the north lateral combined. An examination of the main tile and of the north laterals showed that these tile were not obstructed. Openings were made and the north laterals were laid bare for a short distance.

After a short time the water flowed into the openings and stood at a distance of 30 inches below the surface of the ground, and *stood 6 inches deep over the bare tile,* showing that where the tile was laid in the raw muck the water could not enter the tile as the pores and joints of the tile were stopped up by the raw muck. Fifteen openings were made in the unproductive areas reaching to the water bearing gravel. The gravel was found at different depths from 5 to 8½ feet. But in every case as soon as the gravel layer was reached the water *at once rose in the hole until it stood at 29 to 30 inches below the surface of the ground.*

Some of these holes were left open during the summer and examinations made from time to time showed that the water level remained the same. It is evident then that this unproductive area has under it a sheet of water fed from a source high enough to maintain this constant water level. An opening was also made at the point 1 in the productive part of the field. The water bearing gravel was found at 60 inches, and as soon as the gravel was reached the water rose in the hole to 42 inches below the surface and remained at this level during the season. It is evident then that the south lateral of the tile system which *passes through gravel for a short distance at a depth of 42 inches has reduced the water level of that part of the field to the same depth as that at which the tile is placed.*

The thickness of the various layers differ somewhat in different parts of the field, but the following sections are typical ones. The holes were dug Aug. 22, 1892, and temperature reading taken by inserting a thermometer into the sides as the work progressed.

In the fertile soil a small local vein of water probably due to the space occupied by a decayed root, was found and the variation in the temperature at 42 inches was probably due to water from a higher level falling in this as the depth of the hole increased.

At the time of taking the temperature the ground had a corn crop on it. Possibly the lower temperatures of the productive land was due to the fact that the ground was more heavily shaded by the crop.

All the observations on this soil lead to the conclusions that the real difficulty was the *high permanent water level.* An examination of the corn roots in the fields in Tippecanoe, Carroll, White and

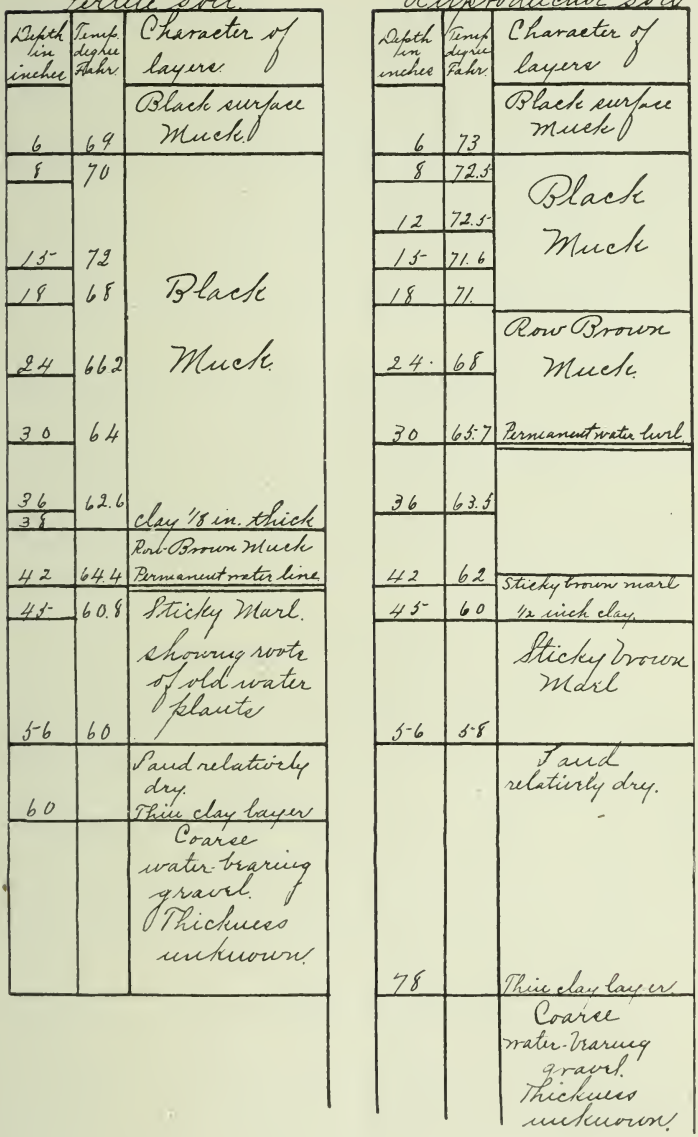

Fertile Soil
Depth in inches
Temp. degree Fahr
Character of layers
6
69
Black surface Muck
8
70
15
72
18
68
Black
24
66.2
Muck
30
64
36
62.6
38
clay 1/8 in. thick
Rot. Brown Muck
42
64.4
Permanent water line
45
60.8
Sticky Marl.
Showing roots of old water plants
56
60
Sand relatively dry.
60
Thin clay layer
Coarse water bearing gravel. Thickness unknown.
Unproductive Soil
Depth in inches
Temp. degree Fahr
Character of layers
6
73
Black surface Muck
8
72.5
12
72.5
15
71.6
18
71.
Black Muck
24
68
Row Brown Muck.
30
65.7
Permanent water level
36
63.5
42
62
Sticky brown marl
45
60
½ inch clay
56
58
Sticky brown Marl
Sand relatively dry.
78
Thin clay layer
Coarse water-bearing gravel. Thickness unknown.

FIG. 2.

Clinton counties showed that when the roots reached the permanent water line the tip of the roots turned black and that the tissue was destroyed. With this destruction of the tip of the root the corn plant turns yellow and from this time forward the plant is in an unhealthy condition. Many of the stalks bear no ears and where ears form there are very few that are marketable. During September many of the stalks fall down owing to the weakness of the stalk between the ear and the ground. The stalks are almost always hollow and nearly free from pith.

The white material that is often found on the surface of this kind of land and is supposed to be "white alkali" has, in all the cases examined, been found to consist of a low form of fungus, the growth of which is favored by the moisture and richness of these soils.

On some of these lands farmers report that when the surface is dry there is much annoyance caused to men and animals by the intense itching which arises after working a short time on the land. In the cases I have examined, this trouble seems to be due to minute sharp pointed particles of silica which represent the skeletons of low forms of life present in the water when the formation of the muck bed was in progress. There seems to be no remedy for this trouble except the better protection of the legs of men and animals that work on the land.

WHY ARE THESE LANDS UNPRODUCTIVE?

After an experience of eleven years in making observations and experiments on lands similar to those described above, I am convinced that in every case that I have examined, the difficulty arises from bad drainage and a failure to reduce the water level to the proper point. I believe that for corn culture (and these lands are of high value as corn lands and often not desirable for other crops) the permanent water level should be reduced to 42 inches. It is certain that with a permanent water level of 30 inches, very little corn can be raised, while with a permanent level of 42 inches first-class crops have been grown continuously for 30 years.

METHODS OF IMPROVEMENT.

While there is no question that proper drainage is the best method for permanent improvement of these lands, the fact that the lowering of the permanent water level by the ordinary means calls for an outlay that the owners are not always willing or able to make at once, justifies one in trying to find some means for the *temporary improvement of these lands.*

For this purpose field experiments were undertaken in the spring of 1892, on the farms of Mr. S. T. Virden, at Guernsey, White county, and on the farm of Mr. John McCoy, eight miles south of LaFayette in Tippecanoe county.

The experimental work included sub-soiling to a depth of 18 inches, and the treatment of the soil with lime, straw and kainit. Kainit is one of the German potash minerals, consisting mainly of the sulphates and chlorides of potash and magnesia and common salt. The usual cost is about $15 per ton, plus the freight from point of purchase.

EXPERIMENTS ON McCOY FARM.

A strip of ground in the unproductive portion of the field was selected and eleven plats staked off, each wide enough for four corn rows, 14 feet 8 inches, and long enough, 149 feet, to make the area of each plat equal to 1-20 acre. The arrangement of the plats is shown in the following diagram:

Ordinary plowing.	1.	Straw.
	2.	Nothing.
	3.	100 lbs. kainit.
	4.	100 lbs. kainit, 500 lbs. lime.
	5.	500 lbs. lime
Subsoiled	6.	Straw.
	7.	Nothing.
	8.	100 lbs. kainit.
	9.	100 lbs. kainit, 500 lbs. lime.
	10.	500 lbs lime.
	11.	Nothing.

The straw applied was rather short wheat straw and a layer about three inches thick was plowed under. The lime was removed from the barrels sometime before plowing and was allowed to air slack. All the material was plowed under on May 23 after long continued rain. Much care was exercised to secure an even distribution of the material. Owing to unfavorable weather the corn was not planted until the second week in June. The corn on the plats to which kainit or straw was applied made a continuous growth,

and after the middle of July these plats could readily be distinguished from a distance by a darker color. The treated plats did not ripen as early as the others and the fodder was slightly damaged by frost on Sept. 27, although no injury was done to the ears. The corn was cut on Oct. 3rd, and husked on Oct. 19.

The result of the experiment calculated to the acre basis, appear in table 1.

TABLE I.

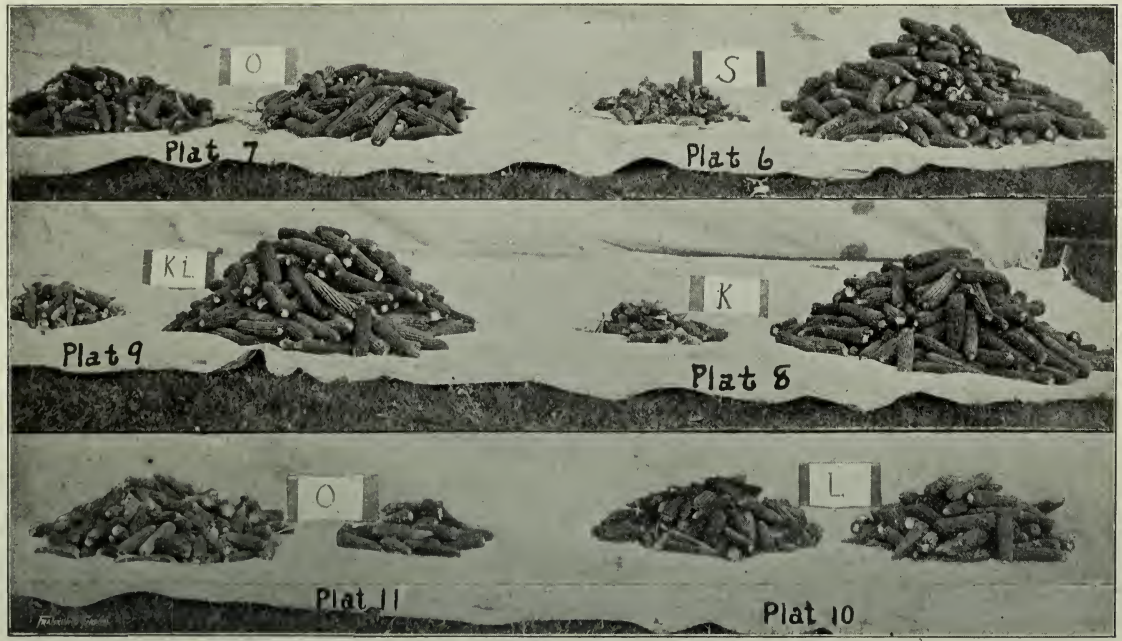
Plat No.	Plowing.	Treatment.	Yield per acre.		
			So'nd corn bushels.	Poor corn, bushels.	Fodder tons.
1	Ordinary.....	Straw.....	48.4	5.1	2.30
2	"	None.....	28.6	11.0	1.39
3	"	Kainit.....	55.8	4.4	2.43
4	"	Kainit..... Lime.....	52.4	6.8	2.48
5	"	Lime.....	25.1	11.6	1.48
6	Sub-soiled.....	Straw.....	48.6	4.5	1.92
7	"	None.....	16.1	12.0	1.04
8	"	Kainit.....	60.4	2.3	2.43
9	"	Kainit..... Lime.....	52.0	2.2	2.21
10	"	Lime.....	15.04	10.5	1.04
11	"	None.....	4.0	12.6	0.96

In this preliminary test no spaces were left between the plats as it was desired to leave a strip of unproductive land beyond plat 11 for further investigation. When the crop matured it was evident that plats 2 and 7 had derived much benefit from the applications made to the plats on each side of them. It was found that the roots of the corn on plats 2 and 7 extended over into the plats on either side of them. The results from all the plats are given, but plat 11 is the only one that bore any resemblance to the untreated portion of the field, and in making comparisons, moreover, the difference between plat 11 and plat 2, 24.6 bushels, ought to be credited to the treatment on plat 1 and plat 3 and the difference between plat 11 and plat 7, 12.1 bushels ought to be credited to plats 6 and 8, in order to get a correct idea of the effect of the materials applied. If this be done it will bring the yields of sound corn on plats 1, 3, 6 and 8 fully up to the average of the productive part of the field. Plat 7 derived less benefit from the adjoining plats probably on account of the subsoiling which permitted the roots to go downward rather than laterally.

PLAT 8
KAINIT
PLAT 7
NOTHING
PLAT 6
STRAW

PLAT 11
NOTHING
PLAT 10
LIME
PLAT 9
KAINIT-LIME

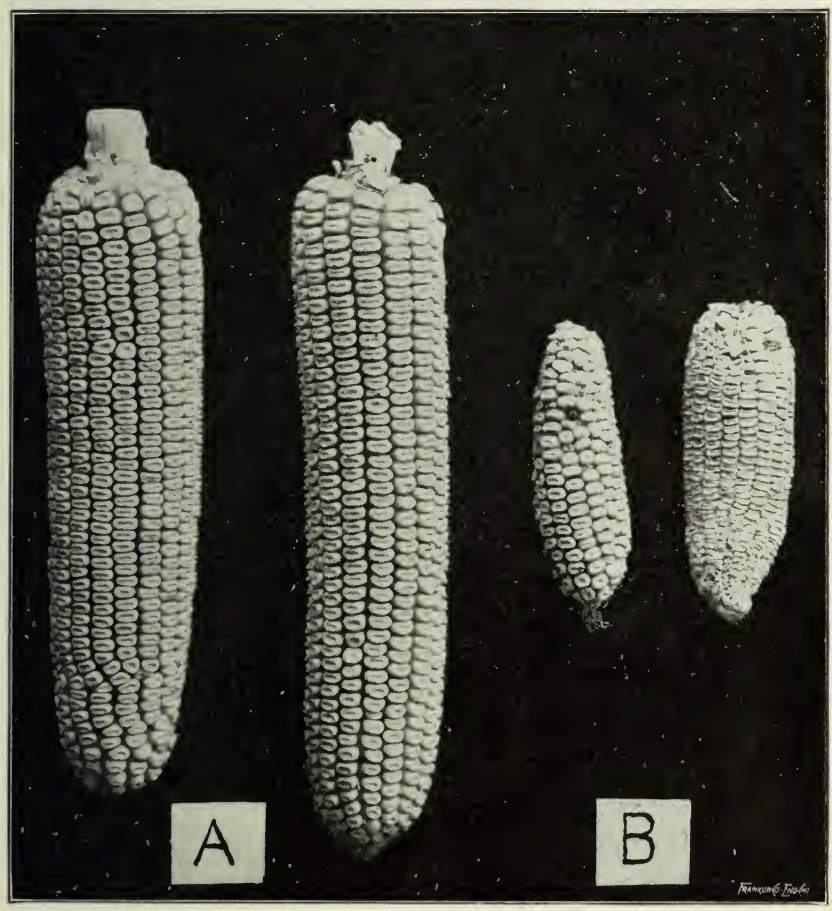
SIDE VIEW OF PLAT 11



Bad corn. Sound corn. Bad corn. Sound corn.

The appearance of the ends of plats 6 to 11 on October 3d are given in plates I and II, and the appearance of a part of the side of plat 11 is shown in plate III. The crop from these plats showing the good and bad ears is shown in plate IV.

As these plates do not show the quality of the bad corn very clearly the appearance of typical ears of each is shown in Fig. 3.



A. From treated plats. FIG. 3. B From untreated plats.

In this experiment it appears that the best yield was obtained from the use of kainit, the next best from the use of kainit and lime, and the next best from the use of straw. But it is to be noted that on both plats 4 and 9 where kainit and lime were used that the yield is less than where kainit alone was used. The lime appears to give a slight increase on plats 5 and 10, but in my judgment this increase is derived from the materials applied to the adjoining plats. The lime does not appear to mix readily with the soil and four years after the lime was applied, the plats receiving lime could readily be located by the lime on the surface.

AFTER EFFECTS OF THE TREATMENT.

Since 1892, no further materials have been applied to the plats, but observations were continued on them. The tileage operations and the tendency of the corn roots to extend laterally has nearly obliterated plats 2, 5 and 7, and they can only be located by observing that in one or two rows there are more bad ears and a few hollow stalks that have broken down; plats 10 and 11 are still well defined.

It was not considered desirable to make weighings of the crop on account of this. At this time, the whole area embraced in plats 1 to 9 presents practically the some appearance as the productive portion of the field and is sharply defined against the unproductive portion surrounding it. The crop on these plats during the years 1893 to 1902, has in the judgment of the owner and of myself been better than in 1892.

COMMERCIAL BEARINGS OF THE WORK.

All who have watched the progress of the experiments have agreed that the yields of the past ten seasons on the treated plats have exceeded the yields of the first season. It, therefore, seems that one will be justified in calculating the returns on the yields of 1892. On this basis the application of a three-inch layer of straw in 1892 has given a net increase of no less than 44 bushels of sound corn per acre for eleven years, or a total of 484 bushels. I think that any farmer will admit that this is ample return for the expense of spreading and turning under a three-inch layer of straw.

The net returns from the use of one ton of kainit per acre are not less than 54 bushel per acre for eleven years, or a total of 594 bushels. A ton of kainit can be purchased and distributed on any field in Indiana for not more than $20. During these years the average selling price of corn at this point is estimated at 35 cents, giving a return of $207.90 for the investment of $20.

In the case of small areas of unproductive soil in fields, it is the custom of farmers to plow and plant this unproductive area the

same as the productive part of the field. The treatment of these small areas with straw or kainit will render the labor applied to these places effective. There is every reason to believe that the influence of the treatment will be effective for some years to come so that the statement above does not include the total return, but only what has been obtained from eleven crops.

EXPERIMENTS ON THE VIRDEN FARM.

The unproductive soil on this farm is in small areas, not often over one acre in extent.

The top soil contains more mineral matter than that on the McCoy farm. The sub-soil is clay, resting on yellow sand, which in turn is underlaid by water-bearing gravel. An examination showed that the water level was about 30 inches below the surface of the unproductive soil. The unproductive soil is in low places and an examination showed that a sheet of water underlaid the whole field. The productive soil was high enough above the unproductive area to make the permanent water level from 40 to 60 inches below the surface of the productive soil. In favorable seasons the land produces from 40 to 60 bushels of corn per acre. On the unproductive areas of this farm, clover and grasses do fairly well, but corn is practically a failure. In the spring of 1892 a piece of unproductive land on this farm was selected in a field that was to be planted in corn. A portion of this area had received a dressing of manure during the winter. The manured area was included in plats 2, 3 and 4, and on this account these three plats received a dressing of manure over the remainder of the unmanured portions of them. The diagram following shows the plan of the plats and the treatment of each.

1.	Subsoiled.
2.	Manure.
3.	Manure.
4.	Manure.
5.	Lime, 500 lbs.
6.	Lime, 500 lbs.; kainit, 100 lbs.
7.	Nothing.
8.	Kainit, 100 lbs.
9.	Straw.

Owing to continued rains the land was not plowed until June 22, the materials having been distributed the day before. The corn was planted June 22. The ground was so wet that the sub-soil plow did not work to advantage.

The late planting and wet season prevented the ripening of the corn, and both fodder and ears were seriously injured by frost. For this reason the corn was not sorted. An examination of the field at the end of September showed that there was a marked difference in favor of the treated plats and the plats presented practically the same appearance as those similarly treated on the McCoy farm.

The total weight of ears on the plats is given in table 2. Similar weights from the McCoy farm being given for purposes of comparison.

TABLE 2.—TOTAL WEIGHT OF EARS HARVESTED.

Treatment	McCoy Farm.	Virden Farm.
Sub-soiled	87.5 lbs.	25 lbs.
Manure		38 "
Lime	102.5 "	27 "
Lime and kainit	163.5 "	40 "
Nothing	111. "	24 "
Kainit	167. "	42 "
Straw	150.5 "	32 "

In the results from the McCoy farm I have used for the sub-soil and no treatment plats, the plats that occupied as nearly as possible the same relative positions as those in the work on the Virden farm. The real results of the treatment do not appear from such a comparison, as the most marked effect of the treatment with straw and with kainit is not so much to increase the total number of ears as to increase the number of marketable ears and to reduce the number of bad ears. From a personal examination of the Virden field at the end of September I was convinced that the results would have been relatively as good as those on the McCoy farm, if the crop had been permitted to mature.

In regard to the after effects of the treatment, Mr. Virden writes under date of Oct. 29, 1895.

"Our plats had a crop of oats in 1893-94, and corn in '95. Both oat crops grew very rank and lodged some. The yield for the field (10 acres), including plats, was about 41 bushels in '93, and 44 bushels in '94. The plats were in the best parts of the field, and their yield would exceed the average. The stubble was thick and burned well each year. We burned just before sowing in '94, and before plowing for corn this year.

"The corn crop this year is an average one. We have it cut but not husked. I should estimate 33 to 35 bushels to the acre. The drouth badly affected the crop.

"As to noticing difference between the plats, it was very difficult to distinguish. It seemed that the manure and kainit plats were slightly better, but it would have taken close weighing to determine. The lime never seemed much good. The blank plats seem to be about as good as the remainder."

The death of Mr. Virden prevented further observations on this land.

The results of the field work show that there are satisfactory methods of *temporary* improvement—methods that are easily applied and that are exceedingly profitable from a commercial standpoint.

While there is reason to believe that the effects of this temporary improvement may extend over a number of seasons, it is desirable to look for a means of

PERMANENT IMPROVEMENT.

The methods of temporary improvement have been based on *counteracting* the *effects* of the bad condition of the land. The methods of *permanent* improvement must *remove the cause* of this bad condition.

The unproductiveness of the soil in question is caused by bad water conditions, the permanent water level being too near the surface, and to some extent by a lack of available potash.

In raw muck lands the water will not readily enter a tile, and the water moves through such soil with great difficulty. On the unproductive lands the water level is maintained by some source of water in the surrounding higher ground and reaches the muck soil through a water bearing sand or gravel layer below the muck. The water moves very readily through the gravel, and if we can devise some plan of drainage by which a portion of the tile will pass through this gravel layer a permanent water level will be reduced to the level of the tile. Where ever this can be done at reasonable expense it is the simplest and most satisfactory solution of the problem.

Before the drainage of such lands is undertaken, it would pay the owner a thousandfold to make a preliminary drainage survey by digging holes in the muck bed to ascertain the character of the layers below the surface and particularly to learn the depth of the water-bearing sand or gravel that is almost invariably found below such lands. These holes should be left open for a few days to allow the water to take its permanent level. After a few such holes have

been dug the labor may be much lessened by boring holes with a two inch augur, welded to a piece of ¾ inch gas pipe, with a *T* screwed on the top to hold the cross handle. The augur and pipe used by me is about 7 feet long, and two extra sections of pipe five feet long, with couplings provided for deeper borings, should they be found necessary. With such a tool there is no difficulty in telling when the gravel layer is reached and finding out its depth. When the augur is drawn the softer or wet layers usually close the opening behind the augur. If it is desired to work in a clear and dry hole a casing of 2½ inch pipe, made in sections of the same lengths as the augur sections is driven down and the boring made inside of this pipe. By this means the water is kept out and the portions of each layer brought up by the augur are readily examined. The casing is easily pulled up when the boring is finished. A cap should be screwed on the top of the casing when it is driven down.

The distance from the surface to the water bearing gravel often varies several feet in different parts of the field, and from the results of such a preliminary drainage survey a plan may be often worked out by which the permanent water level may be sufficiently reduced to make the whole field productive by laying short lines of the tile in this gravel instead of wasting long lines of tile in the raw muck where they will do little or no good.

Many of these unproductive fields have already been tiled, and in some cases, the tile is laid in raw muck to a depth of 3½ feet, but for the reason already given the field is still unproductive. The question arises whether these old tile lines can be utilized as a part of a system to reduce the permanent water level. In many cases this can be done. Perhaps we can best illustrate the method of procedure by a section of the field on the McCoy farm, and an explanation of how the tile already in position can be utilized. Fig. 4 shows the layers, the position of the tile, and the permanent water levels of a north and south section, extending through both the productive and unproductive portions of the field. The distance below the surface in inches is given at the side. The total length of the section is 650 feet, and of course the depth is much exaggerated in proportion to the length. On this account the slopes appear very abrupt in the figure, while in the field the slopes are low, the steepest found being 3½ feet in 100 feet.

Near the division line between the productive and the unproductive portions of the field, the layers seem to be broken by the intrusion of the clay at point *A*, which prevents the movement of the water in the gravel from the unproductive to the productive side of the field. A similar ridge of clay, rising above the surface between

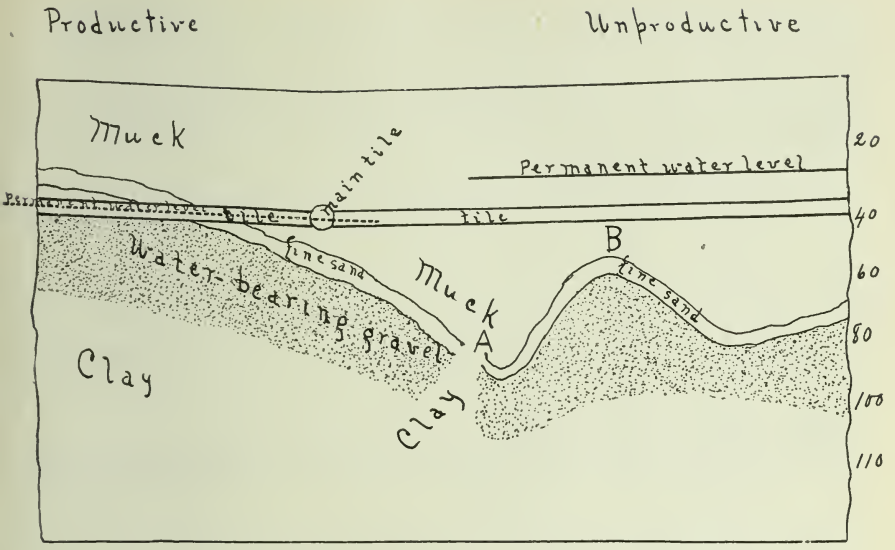


FIG. 4.

the unproductive portion of the field and the creek (See Fig. 1), prevents the flow of water to the creek.

The permanent water level in the productive part of the field is shown at the same level as the tile, while on the unproductive portion the water line is located at 29 to 30 inches, as determined by repeated observations and measurements made in holes left open for the purpose.

The simplest way to reduce this water level on the unproductive portion would be to run a tile line deep enough to strike the gravel at the point *B* where it comes to within 5 feet of the surface. On this land the fall to the creek is great enough to permit this, and the fall of the main tile is great enough to permit a lateral to be 5 feet deep at the point *B* and have sufficient fall to strike the main tile at a distance of about 400 feet from *B*.

In some fields, however, the necessary fall cannot be obtained without digging a main ditch for such a long distance that the value of the reclaimed land would not justify the expense for ditching. In such cases special methods of drainage can be used in connection with the tile lines already laid.

Such an arrangement is shown in Fig. 5 where a well is sunk into the water-bearing gravel and bricked up, the tile line passing through the well. Such a well at once becomes a strong flowing

spring and its level cannot rise above the height of the water in the tile. In case the flow of water is very strong it may be well to run a rod or two of the tile in the gravel and let it enter the well at the bottom. Such a line is best laid in a direction crossing the tile already in, in order not to disturb the old tile line. The tile for this deep line will, of course, have to be laid under water, and it may aid

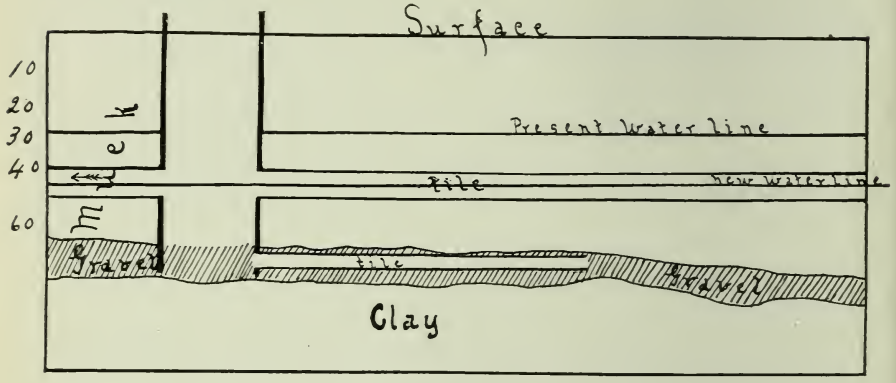


FIG. 5.

in getting these tile in place if they are attached to a wood support shaped like old-fashioned plank drain, before being laid down, as it is difficult to lay tile so far under water and get the joints properly in place.

A few such wells built along the tile line involve but a small expense and will often reduce the water level all that is necessary. By leaving the top of the well open the flow of water in the tile system can be examined at any time.

Another system that has been reported successful has been tried but I have not had an opportunity to make a personal examination of it.

In many places a sheet of water in gravel is found at a depth of 30 to 50 feet below the surface. This gravel is covered with from 20 to 40 feet of clay. This water sheet is at nearly the same level for a comparatively large area and remains practically at the same height throughout the year. Where such a sheet of water underlies unproductive areas that cannot be drained profitably by ordinary means, a well three or four feet in diameter is dug until it reaches this water-bearing layer at a depth of 40 to 50 feet. The tile system is then put in and this well takes the place of the ordinary outlet of the tile system. In this way the basin on top of the clay in which the unproductive soil is found, is connected with the

deep gravel layer and this gravel layer has so great a water holding capacity that the drainage water entering the well is readily carried off.

Of course in putting in such a system care must be taken to put the tile in such a layer that the water can readily enter the tile; and the tile should be laid and covered with especial care in order to prevent mud from being carried into the well and filling it up. Trials with driven wells have been made for this purpose, but the pipe is reported to have become clogged up.

There is another class of "bogus" spots which consists simply of lower places in quite level fields in which it would be very difficult to reduce the tile levels and the spots are so low that the special devices in connection with tile already laid can not be used because the tile if laid through the center of these small low spots would often be not over 18 inches deep. These spots as a rule do not have the characteristics of muck lands nor the springs under them but they have a high water level simply because the surface water from the land about them flows into these low places. The amount of rain actually falling on these spots is not enough to cause any difficulty and if the surface drainage from the surrounding land can be kept out the spots will generally become productive. The ordinary tile layer simply runs the tile through the center of these spots and of course fails to reduce the water level below the level of this tile which is generally too near the surface in these low places although it may be 3½ to 4 feet deep in the higher portion of the field. The simplest way to keep out the surface water from the surrounding land is to divide the tile line at the edge of the spot and send a line around on each side, uniting the lines again when beyond hte spot. This permits the tile to pick up the drainage water from the surrounding land before it gets to the low places. A number of farmers who have tried this simple and inexpensive method have reported it verv effective in transforming unsightly barren spots into the most productive portions of the field.

It often hapens that unproductive black lands have such a situation that a single line of tile may be laid near the division between the muck land and the higher lands near it that will take the water from the layer feeding springs and so reduce the general water level that it will be unnecessary to put any additional tile in the muck land. In such a case it is necessary to have the single tile line so deep that it will be 42 inches below the lowest part of the surface of the muck bed. It is also essential that the tile be laid in a porous layer of sub-soil since water moves very slowly through a sub-soil of raw muck and will hardly move at all through the marl (often mistaken for white clay) which frequently underlies these muck

beds. The raw muck and the marl will often close up the joints and pores of a tile so as to render it practically impervious to water.

Some of the springs about the low areas in northern Indiana contain considerable carbonate of iron in solution. When the water is exposed to the air the gases which aid in holding the iron in solution escape and the iron compounds are deposited as a fine brown sediment. In one case that came under my observation a main tile line had been entirely closed up by a deposit of this kind. Where tile has already been laid in such springy land it is desirable to test the tile to see if any trouble of this sort exists. The roots of trees sometimes enter the tiles and stop them up but most of the unproductive lands are bare so that roots seldom cause much trouble on such lands.

UNPRODUCTIVE BLACK SANDY SOIL.

Practically all of the preceding material is contained in bulletin 57 published in 1895. This bulletin has long been out of print but there has been so much inquiry in regard to this class of land that it has become necessary to publish another edition somewhat revised and to which results of further observations and analyses have been added.

Several advanced students in Agricultural Chemistry, working under my direction, have chosen as subjects of theses the investigation of unproductive black soils found on their home farms.

The muck lands on which experiments were first conducted contained so much organic matter that anything like a mechanical analysis of the soil was impossible. Some of the unproductive black soils investigated later by my students were of another class, consisting mainly of sand and silt. Much soil of this character is found in central and northern Indiana and in the northern counties much of it is not yet under cultivation, while the remainder has been under cultivation for only a limited time. Many unproductive spots are found and where the land has been under cultivation for a considerable time it is reported that the unproductive spots have increased in size.

In some localities large areas of black sandy soil produce good corn crops for two or three years after the first plowing and then fail to yield enough to be profitable. The same thing sometimes happens on muck lands. The explanation is that the moss and water plants that originally covered the land are turned under and for a short period furnish enough plant food and permit enough air to enter the soil to provide for the first crops. But when the effect of these coarse materials is exhausted the productiveness of the land falls off very rapidly.

NEWTON COUNTY.

Investigations by Wm. Simons, 1900-1901.

The soils of this county are of three general types—muck soils, found in the great swamp region along the Kankakee river; sandy soils covering most of the northern half of the county; these shade into what is described locally as a rich prairie loam in the southern part of the county. It was on the last type of soil that the investigation was conducted and the results show that the soils contain more sand and less clay than the usual types of loam.

The soil is considered too sandy for wheat raising.

The farmers who first plowed the prairie, state that the unproductive areas, known locally as "Alkali spots" were not noticed for some time after the lands were brought under cultivation but have gradually developed and are increasing in size. Corn and clover will not grow on the unproductive spots but timothy and oats can be produced to some extent, although the oat crop ripens later than on the neighboring productive land. The unproductive areas are usually more sandy than the productive lands about them and the sub-soil of the unproductive soil is sand while that of the productive soil contains considerable clay. Before the country was drained these unproductive areas were known as "sink holes" or quick sand areas. They are usually located in the lower levels of the fields and surrounded by the most productive land. The owners have found that heavy applications of barn-yard manure will make these spots produce good crops and that when large quantities of straw are burned on the land a good crop follows.

The particular areas investigated were located one mile east and one-half mile south of Kentland. One field was tiled, the lines being 20 rods apart. The unproductive areas were mid-way between the tile lines. Water levels were taken on the 25th of May. Seven spots were examined. On five the permanent water level was found to be over 4 feet below the surface, on one 20 inches, and on another, 30 inches below the surface. In the case of one of the high-water levels the tile was obstructed while in the other the tile was not deep enough, being at the same depth as the water level. On the productive lands surrounding these spots the water lavels were from 3 to 4 feet below the surface. It would therefore seem that other cases than high-water level must be sought to explain the unproductiveness of the first five spots examined.

A quantity of the unproductive soil was extracted with water for 72 hours and the solution examined for soluble salts. Potassium

and sodium sulphates and sodium chloride were the only substances dissolved and these were present in such small proportions (0.0645 per cent.) that no injurious action could be ascribed to their presence.

MECHANICAL ANALYSES.

The unproductive soil contained 95.23 per cent. fine earth (passing 0.5 m. m. sieve) while the productive soil contained 93.93 per cent.

This fine earth on further examination showed the following results:

	Productive Per cent.	Unproductive Per cent 1st 6 inches.	Unproductive Per cent. 4th 6 inches.
Sand.....0.5 —0.25 mm.	14.10	26.87	50.67
Fine sand.....0.25 —0.125 "	12.50	23.54	28.56
Sand and silt....0.125—0.05 "	41.47	20.91	9.11
Clay and dust....0.05.....	16.40	14.21	7.72
Organic matter.....	10.48	10.70	1.34
Moisture.....	3.33	2.64	1.00

It will be noticed that not only is the unproductive soil more sandy but that the sand increases very rapidly as we enter the subsoil. The moistures given are the quantities of moisture retained by the soil after exposure to the air until no further loss occurred.

CHEMICAL EXAMINATION.

The soils were examined by the methods of the A. O. A. C.

	Productive Per cent.	Unproductive Soil Per cent.	Unproductive Sub-soil Per cent.
Insoluble in H Cl.....	81.26	82.34	92.88
Soluble in H Cl			
Phosphoric acid.....	0.17	0.22	0.07
Potash.....	0.47	0.23	0.23
Soda.....	0.38	0.32	0.19
Nitrogen.....	0.33	0.44	0.04

The soil of the unproductive areas would seem to have a fair supply of total plant food, although the potash is only one-half of that on the productive land. The fact that in the sub-soil the reduction of organic matter is accompanied by a corresponding reduction of phosphoric acid and nitrogen while the potash remains constant, suggests that the potash is probably in a much less available condi-

tion than the other plant foods and that this may in part at least account for the failure of corn and clover on the unproductive spots where the drainage is satisfactory.

It is quite possible that even on the productive lands the potash may not be in an available form, for on lands of this same character in other counties the application of from 75 to 150 pounds of kainit to the acre has given very profitable returns with the corn crop.

HENDRICKS COUNTY.

Investigation by Julian Ensminger, 1900-1901.

The unproductive soils in this county occur in spots or narrow strips on which water stood nearly all the time before the country was drained. Both the productive and unproductive soils are very loose dark loams containing considerable organic matter, and presenting practically no difference in appearance. The sub-soils are stiff heavy clays. The water stood but 16 inches below the surface on the unproductive land while on the productive land the water level is practically down to the tiles, 40 inches.

The mechanical analyses of these soils show:

	Productive Per cent.*	Unproductive Per cent*
Sand..... 0.5 —0.25 m. m.	2.52	9.24
Sand..... 0.25—0.05 "	16.14	17.24
Silt..... 0.05—0.01 "	76.50	69.05
Dust..... 0.01.....	4.69	3.35
Organic Matter.....	14.26	13.16
Moisture.....	4.12	3.44

The chemical analyses show:

	Productive Per cent	Unproductive Per cent
Insoluble in H Cl.....	71.96	73.94
Soluble in H Cl		
Phosphoric acid.....	0.284	0.222
Potash.....	0.680	0.181
Nitrogen.....	0.473	0.557

The high-water level of this land would prevent the production of all ordinary crops and must be reduced before the best results can

*The percentage of sand, silt and dust were calculated to basis of mineral matter only.

be expected from any other treatment. The great difference in the amount of potash in the two soils, otherwise quite alike, would indicate the desirability of using potash in this class of land after the drainage is made satisfactory.

FOUNTAIN COUNTY.

Investigation by Julian Ensminger, 1900-1901.

This land is a part of prairie that was formerly dotted with clumps of jack oaks on the higher part of the land. The unproductive soil is found where one of these groves grew and has been unproductive ever since the land was cleared. The area of the unproductive place has constantly been increasing.

The tiles in the land are 3 feet deep and as the unproductive spot is higher than the general level of the field and the soil is open the unproductiveness cannot be attributed to high-water level. The soil is in fine physical condition and has the appearance of very fertile land. Heavy applications of farm-yard manure cause it to produce a fair crop but without manure the plants live but a few days after they appear above the ground. For purposes of comparison Mr. Ensminger selected a fertile river bottom soil subject to overflow.

MECHANICAL ANALYSES.

	River Bottom Per cent.*	Unproductive Per cent.*
Sand..... 0.5 —0.25 m. m.	1.34	9.74
Sand..... 0.25—0.05 "	10.13	7.45
Silt..... 0.5 —0.01 "	83.69	80.88
Dust..... 0.01	3.92	1.91
Organic matter.....	6.63	8.96
Moisture.....	2.52	2.37

CHEMICAL ANALYSES.

	River Bottom Per cent.	Unproductive Per cent.
Insoluble in H Cl	79.37	81.95
Soluble in H Cl		
Phosphoric acid	0.123	0.154
Potash.....	0.428	0.281
Nitrogen.....	0.131	0.186

*The percentage of sand, silt and dust were calculated to basis of mineral matter only.

On this unproductive land it would be desirable to conduct systematic experiments with phosphoric acid and potash. The probability is that the potash is not in an available condition and the same may be true of the phosphoric acid. The nitrogen supply seems to be fairly good but possibly there may not be enough lime present to insure rapid nitrification. Organic matter plowed under might be useful in increasing the water holding capacity.

On the sandy black soils of Northwestern Indiana there has been a marked increase in the use of fertilizers during the past three years. In some cases kainit alone has been used and in other cases a phosphate and potash containing 8 to 10 per cent of soluble and reverted phosphoric acid and 4 to 5 per cent of potash has been used. Such a mixture frequently consists simply of two parts of acid phosphate of high grade (14 to 16 per cent soluble and reverted phosphoric acid) and one part of kainit. The usual application is from 100 to 200 lbs. per acre. It is quite likely that heavier applications than 200 lbs. per acre would prove profitable.

In judging of the effects of fertilizers containing no nitrogen it is very necessary to actually weigh or measure the crops from equal areas of fertilized and unfertilized land, for such fertilizers do not give striking results in the color of the foliage even when there may be a considerable increase in the quantity of the grain. In estimating the yield in such cases farmers have often said that they could see no difference in fields on which actual weights showed a difference of 10 to 15 bushels per acre.

UNPRODUCTIVE MUCK OF DELAWARE COUNTY,

Investigation by L. V. Shoemaker, 1900-1901.

These soils in general appearance and texture resemble the soils of the McCoy farm. The lands are located 2½ miles east of Daleville. Two samples of unproductive soil and two of productive soil were selected for examination.

The Chemical examination showed:

	Unproductive Per cent		Productive Per cent	
Moisture	10.03	6.25	4.09	3.37
Organic matter	48.14	34.15	18.77	12.97
Insoluble in Hydrochloric acid	40.70	47.97	64.86	72.78
Soluble in Hydrochloric acid				
Phosphoric acid	1.01	0.46	0.16	0.36
Potash	0.32	0.35	0.21	0.22
Nitrogen		1.38		0.45

The phosphoric acid in the unproductive soils was so much higher than had ever before been noted in this State that the results were carefully checked on new samples. In these soils the plant foods are much more abundant than in the productive lands in the same fields.

The unproductive muck is 18 to 28 inches deep and is underlaid with sticky marl. The land is drained by a large open ditch into which the tiles discharge.

The water level on the unproductive area was found to be 25 inches below the surface while on the productive area the water level was 33 inches.

These readings were taken May 4. On May 17 the water on the unproductive area at stood at 25½ inches and on the productive area at 34½.

The first thing to do with this land is to secure adequate drainage. Probably the sticky marl prevents the water entering the tiles. The supply of plant food would seem to be abundant and with proper drainage and aeration it ought to become readily available.

All of the unproductive muck lands that I have examined can be drained and made productive by one of the methods mentioned above. But before any special method is determined upon, it will always be both desirable and profitable to make a preliminary drainage survey of the land in question in order to determine its present water level and the depth below the surface of the real water-bearing layer. With these facts before us the most economical method of reducing the water level can be determined upon.

SUMMARY.

1. Thousands of acres of ground, now unproductive, may be improved and made the most productive corn lands in the State.

2. The use of straw or kainit has proved very profitable as a means of *temporary* improvement of such lands.

3. The *permanent* improvement of such lands demands, in addition to the above treatment, *efficient* drainage. This drainage will usually be of a special character.

4. Before making any outlay for the permanent improvement of such lands a preliminary drainage survey should be made, and the system of improvement should be based on the results of this survey.

5. On black lands containing considerable sand but not having a high-water level, kainit and other potash-salts have proved very profitable fertilizers for corn. The other potash-salts are muriate of potash and sulphate of potash. They contain about four times as much potash as kainit. The application should be from 25 to 50 lbs. per acre to equal the usual application of kainit. A pound of actual potash in the form of high-grade salts costs less than in the form of low grade.

On this class of land it might be well to try phosphoric acid, in addition to the potash salts, at the rate of 100 to 200 lbs. per acre of high-grade acid phosphate.

Much land of this character is found in the Northern counties of the state.

Purdue University

Agricultural Experiment Station

BULLETIN No. 96. VOL. XII.
JULY, 1903.

SUGGESTIONS CONCERNING

CARE OF MILK AND BUTTER MAKING ON THE FARM.

Published by the Station:
LAFAYETTE, INDIANA,
U. S. A.

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SUGGESTIONS CONCERNING CARE OF MILK AND BUTTER MAKING ON THE FARM.

H. E. VanNorman, B. S.

While Indiana is not counted among the leading dairy states, there is a large amount of milk produced which reaches Chicago, Louisville, Cincinnati, Indianapolis, Fort Wayne, Evansville and other cities, in the form of milk, cream and butter, to say nothing of that which finds a market closer home.

The comparatively little study given the subject of farm butter making and care of milk by the large number who "only make enough to supply the family and sell or trade the surplus at the store," or "send a little to the creamery after the calves are weaned;" the possibility of increasing the income from the few cows kept, together with the frequent calls upon the Experiment Station for information relating to the care of milk, butter making, separation, etc., has prompted the preparation of this bulletin of general information which is not a report of original research; rather a gathering together of useful data and suggestions not easily accessible to the farmer.

In the new agricultural building there has been equipped a dairy laboratory for teaching and experimental purposes. It is the wish of those in charge to make this department of the Experiment Station as useful to the state as possible; to this end those interested are invited to correspond with and call upon the Dairy Department for such assistance as it can render.

Information is desired regarding the location of creameries, cheese factories and the development of the dairy interests in general.

INDIANA CONDITIONS.

The last Government Census shows 221,897 farms in Indiana, 214,366 of which are reported as having milch cows, or 96.5 per cent of Indiana farms have milch cows on them, while only about three per cent of the farms derive as much as 40 per cent of their income from the sale of dairy products, and are therefore called dairy farms. The great mass of farms undoubtedly belong to the class where cows are kept to supply the family with milk and butter or to raise beef calves and are only milked for a time after the calves are weaned. The surplus over and above the family needs is disposed of in the form of butter to the huckster or the grocer and often paid for in trade, bringing only 12 to 15 cents per pound. Much of this butter, because made under unfavorable surroundings, as a

secondary consideration and in rather small amounts, does not find a ready market among consumers but goes to the huckster, the country store and eventually the renovating factory, where it is melted, clarified, churned with milk or cream, worked, salted and sold to the consumer in the larger cities at from five to ten cents per pound more than the producer received. Not infrequently the consumer has asked for the best creamery butter and thinks he is receiving what he has paid for, when in reality it is renovated butter. The law now requires that renovated butter be so marked, which in a measure protects the purchaser.

Believing that there is a large loss annually to the Indiana farmers in producing 12 to 15 cent butter, when the consumers, especially in our large towns and cities, complain of an insufficient supply of the best butter, and openly say that they prefer oleomargarine to much of the country butter they are forced to take, the following suggestions are offered with the hope that some may be in a position to take advantage of them.

First. If possible send the milk or cream to a good creamery, where, with the necessary apparatus and some one who makes a business of buttermaking, you will have the advantage of the higher price that large shipments of butter of uniform quality command, to say nothing of the increased yield of butter which may be secured with the separator as compared with the gravity methods usually of necessity employed on the farm where dairying is not made a business of; or the saving in hard work which commonly falls to the lot of the women folks.

Second. If the creamery is not available, study the principles involved and methods employed by the best butter makers, and make such changes in your methods as may be necessary to enable you to make a first class article which will command at least 20 or 25 cents per pound on the market. Then keep cows and make enough butter to warrant the care necessary to make butter of uniform excellence and enough of it to pay to get it to a profitable market.

Third. If neither of the above plans are practicable under your conditions, make just as little butter as possible to be sold at 15 cents per pound or less, as the margin of profit, if any, is too small to justify the hard work and time required in making cheap butter, and the market is overstocked with it.

The last Government census report also shows that the average Indiana milch cow only produces $27.40 worth of dairy products per year, while careful estimates show that the ordinary cow eats feed which at market prices is worth from $29.00 to $32.00 a year. The Experiment Station records show that many cows, reasonably well fed and cared for, will produce 250 pounds of butter which,

at 20 cents, would be $50.00 for the year's product as compared with the low average above. In the leading dairy counties of Illinois, the average returns for all the cows, good and bad, is from $43.00 to $50.00 per cow per year.

Making due allowance for errors in figures and in judgment the fact remains that the income from many of the cows now on Indiana farms, does not pay for the feed eaten. In very many cases the returns can be increased by some change in the methods of care and feed of the cows to reduce cost and increase yield, and in care of milk and butter to save loss and improve quality.

A further study of the returns from the individual cows in the herd will frequently show that there is one or more cows which produce from one to ten dollars less milk or butter, in a year, than the value of the pasture and feed eaten. If such individuals were disposed of even for little or nothing the remaining cows in the herd would show a larger margin of profit.

SUGGESTIONS ON CARE AND FEED.

Have some oats and peas, sweet corn, sorghum, early planted field corn, other forage crops, or left over silage, to supplement pastures in dry time.

Allow the cows in a darkened shed or barn in fly time.

Keep the cows out of the stalk field in winter. Cut the corn and feed fodder in the stable or yard.

Shelter from raw winds, even on bright days in the winter.

Feed a combination of feeds from the following lists, at least one from each rather than only one or two from either, and that corn, and corn stover or timothy hay.

I	II
corn	alfalfa hay
corn stover	bran
corn silage	clover hay
millet hay	cow pea hay
oat straw	cotton seed meal
sorghum hay	gluten meal
timothy hay	linseed meal
wheat straw	oats
	soy beans

Since the feeds in the first column are rich in fat and heat producing material, and especially poor in protein, which is absolutely necessary for milk production, and the feeds in the second column

are all much richer in protein, a larger yield of milk will be secured when a combination of feeds from the two groups is fed.

Breed the cows to calve in the early fall, and make the most milk and butter at the season when conditions are favorable for making and prices are high, and there is more time to care for the cows, the milk and butter.

Don't breed to a scrub sire. The best one available is none too good.

Raise the calves by hand and substitute vegetable fat in the form of ground flaxseed jelly, and later corn meal, etc., in connection with skim milk, for the butter fat in the whole milk.

Know which cow is not earning her feed and dispose of her.

Brush with a brush or wipe with a damp cloth the udder and flank before milking. Twenty to 90 times as much dirt falls in the milk from the unbrushed, unwashed udder as from the washed one.*

Milk with dry hands.

Don't allow the milk to stand in the barn.

Don't use a so-called dilution separator; set a can of milk into cold water, but don't mix water and milk. An eighth to a third of the butter fat is often lost by diluting the milk with water.**

Don't mix sweet and sour cream less than 12 hours before churning.

Own and use a dairy thermometer—cost 25 to 50 cents—it will save many times its cost, if it is used and the cream is churned at the right temperature. They may be had from any dairy supply house and very often from the local druggist. They should be all glass. The cheaper ones are not always accurate and should therefore be compared with a reliable one.

Salt by weight or measure—not by guess.

Wash the butter milk out.

Don't overwork the butter; it injures the texture.

Have a butter worker; it saves laber and helps quality.

Put butter in rectangular prints, (they are more attractive and pack better.)

Use parchment paper, not wax paper.

Use dairy salt; not table or cheap barrel salt.

Encourage some young member of the family to take charge of the butter making, and make a business of it. A Hendricks county girl who learned to make good butter, makes a business of it, has increased her trade from the product of three cows to that of 15, and could sell more butter if she had it.

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*Illinois Bulletin No. 84.

**Cornell New York Bulletin No. 151.

Be prompt and regular with delivery.

There is a reasonable profit in good cows well cared for.

There is a good market for more first class butter, milk, cream and cheese than is produced.

Indiana is nearer the great markets than many of the leading dairy states.

Much land in the state is better adapted to dairying than to grain farming.

Much land needs the manure that can be produced by keeping more good milch cows upon it.

CARE OF MILK FOR CREAMERY, CHEESE FACTORY OR SHIPPING.

The Cow.—The first essential for good milk is to prevent the dirt getting into the milk. It takes but a moment to brush the udder and nearby parts just before milking. It is even better to wipe them off with a damp cloth, as the dust will then adhere to the damp hair rather than fall into the pail.

The milk should be removed from the stable as soon as possible, as it absorbs stable odors very quickly.

Strainers.—With the best of care there will be some foreign matter fall into the milk, which a strainer will remove. A fine wire strainer is better than none, but two or three thicknesses of cheese cloth, if properly cleaned each time after using, is one of the best strainers available. The strainer cloth should be rinsed in cold water, washed clean in warm water, scalded and hung in the sun if possible.

Strain, and cool by placing the can in cold water and stir a few times within the first hour. Use a thermometer enough to know whether it gets cold or not. If necessary, change the water. It should be down to 50° F. at least, and the nearer 40° the better.

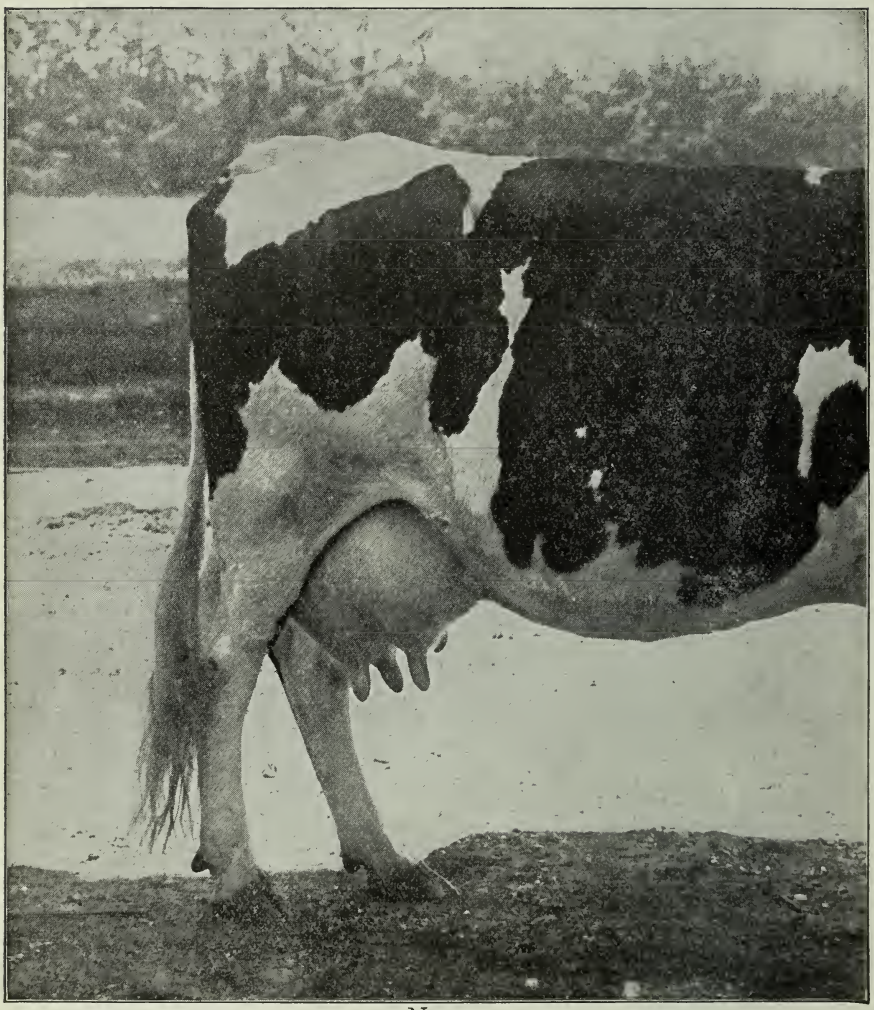
It is the *getting* the *milk cold* which counts, not the putting it in the water. A can of milk will cool faster in water at 45° than in the air at 35°.

Keep tight covers off the cans while cooling, to allow escape of animal gases and heat. No objection to light cloth cover to keep out dust and flies. Be sure the air is pure where the milk is exposed.

Do not mix warm milk with cold, as it will sour both very soon.

HANDLING SEPARATOR CREAM.

The same care and general plan should be used in handling separator cream, either for shipping or for the creamery. The



No. 1.

Cut No. 1.* A source of Human Food. Clean, even in Mid-Winter.

*Bulletin No. 84 Illinois.

No. 2.

Cut No. 2.* After a Run of Three Weeks on Pasture. Imagine the Filthy Condition During Winter.

separating should be done as soon as the milking is finished, as the milk is then usually warm enough to separate most thoroughly.

Cool and stir the cream immediately after separating. Do not mix warm and cold cream. Cool the warm cream first.

Keep the cream in cold water if possible.

Wash the separator thoroughly after every using, scalding with boiling water the last thing.

WASHING MILK UTENSILS.

First rinse with cold or luke warm water; wash thoroughly with water as warm as the hands will stand, using some good alkali washing powder, such as sal soda, Gold Dust, etc. Rinse thoroughly with boiling water and if possible place in the sun shine.

If wiped dry with a clean towel the tin will be brighter, but if made thoroughly hot by the rinsing, it will dry without wiping, will not rust and be cleaner than if wiped with a towel which is damp and as unsanitary as is frequently used. Use a brush, not a cloth, for washing tinware.

CREAM SEPARATION.

Milk is "an emulsion of fats in a watery solution of Alkaline salts, casein and sugar."*

The average composition of milk is as follows:*

water	87.17%
fat	3.69%
casein	3.02%
albumen	.53%
sugar	4.88%
ash	.71%
Total	100.00%

"Cream is that portion of the milk into which most of the fat has been gathered."*

Fat being lighter than the water or the solids not fat (sugar, casein, etc.) raises to the top when allowed to stand in a vessel, and in so doing carries with it a little of the other solids not fat, and constitutes what we commonly call cream. The heavier portion (i. e. skim milk) settles to the bottom by reason of the force of gravity.

*Wing—Milk and its Products.

METHODS OF SECURING CREAM.

Shallow Pans.—The objection to this method is the large loss of butter fat in the skim milk, the exposure of the cream to undesirable odors and the labor of caring for a large number of vessels.

The best results with pans will be secured when the milk is set at rest immediately after milking, in a room where the temperature is 60° or below. A loss of .6 to .7 per cent of fat in the skim milk is to be expected, while it often runs much higher.

Cold Deep Setting.—The milk is set in deep, narrow vessels, surrounded by cold water. It may be only a common shot gun can (about eight inches in diameter and 22 to 24 inches deep) set in water, in a barrel sawed off the right height, and protected from dust and bad odors; or it may be a high priced cabinet creamer, handsomely painted and trimmed with nickle-plated faucets, knobs, etc. The essential features for best results, are narrow, deep cans, set in water at a temperature of 45° F. or below, for at least 12 hours. The cream may be skimmed off the top with a cup, or better, a cone skimmer, or the skim milk may be drawn off from the bottom by a faucet, stopping so as to leave the cream in the can.

The loss may be only .2 to .4% under favorable conditions, while warm water and carelessness in removing the cream will cause much larger losses.

The Michigan Experiment Station reports the following per cents of fat left in skim milk from milk set at various temperatures.*

	Temperature degrees F.	Average percent of fat in the skim milk.
Milk set in water at	32—36	.19
" " " " "	40	.36
" " " " "	50	.84
" " " " "	58—60	.84
" " " running water	58—60	.84
" " " open air at	62	1.40

These figures emphasize the necessity of having the water cold which surrounds the cans of milk, otherwise the amount of butter fat in the skim milk will be very large. The cans of milk should be placed in the water as soon after milking as possible.

Dilution Separators, so called "water separators" are merely deep cans in which the milk is mixed with water; usually as much water as milk, and allowed to stand two to 24 hours. They usually have a faucet at the bottom for drawing off the skim milk and water, and a strip of glass by means of which the cream line my be seen.

*Michigan bulletin, 167.

There have been many variations and adaptations of the principle of dilution, but all are equally inefficient, and these miscalled "separators" have commonly been sold at exhorbitant prices compared with their cost and merit. The loss of butter fat will be from .7 to 1% under favorable conditions, and usually much more, especially if allowed to stand only three or four hours before skimming.

THE HAND SEPARATOR.

In the commercial world the word "separator" as applied to the dairy business is used to mean a machine with which cream is secured by substituting centrifugal force for the force of gravity.

In the mechanical separator a small steel bowl is made to revolve very rapidly, developing centrifugal force, which is spoken of as the tendency to fly away from the center around which it is moving. Swinging a bucket of water over one's head fast enough so the water does not come out even though the bucket be upside down, is an illustration in which the centrifugal force, being greater than the force of gravity, the contents stay in the bucket. The old game of crack-the-whip is another illustration. The faster the speed the greater the centrifugal force. In the mechanical separator the bowl revolves so fast that there is sufficient force to bring the heavy portion of the milk, that is the skim milk, next to the wall of the bowl immediately, forcing the cream toward the center. By a suitable arrangement of outlets the skim milk is pushed out at one and the cream another as more milk is let into the bowl. The process is a continuous one.

The advantages of the hand separator are, 1—The gathering of practically all of the fat into the cream, thus reducing the loss in the skim milk to the minimum; 2—The milk may be separated immediately after milking, so the skim milk may be fed while it is still warm with the animal heat, (which adds considerably to its feeding value as compared with cold skim milk warmed up). 3—Only the cream, which is about one sixth of the milk, needs to be cooled. Often a suitable place for the separator may be found at or near the barn, in which case only the cream and the parts of the machine to be washed have to be carried to the house, which is a considerable saving of labor over carrying all the milk to the house and the skim milk back to the barn. 4—The thickness of the cream may be controlled. 5.—There is undoubtedly a saving of labor as compared with handling much milk in either pans, crocks or deep setting. 6.—Much of the dirt getting into the milk during milking, which is not dissolvd by the warm milk, is left in the bowl or thrown into the

skim milk, so under certain conditions the quality of the cream for butter making is improved. But the separator won't take out the *filth that has been dissolved.*

The chief objection to the separator is its first cost, which is from $60.00 to $125.00 for farm size machines, depending on the amount of milk they will skim per hour.

In buying, it is well not to get a very small machine, as it takes too long to run the milk through; if later two or three more cows are added the time required for turning the small separator is considerable, while the difference in first cost of the larger machine will soon be made up by saving in time required to skim each day's milk with the larger size.

Some desirable features of a separator are—

1.—Clean skimming under a wide range of conditions, such as warm and cold milk and thick or thin cream. The skim milk from a good separator properly run should not contain to exceed .05 of one per cent of fat, and under ordinarily favorable conditions should show even less than that in the double neck test bottle.

2.—Ease of washing; all parts should be so arranged as to be easily gotten at for washing, few corners and tubes.

3.—Easy running. All machines of the same manufacture are not equally easy running.

4.—Durable construction, few parts, well made. We have in our dairy department several makes of separators which do satisfactory work. Each has its admirers among the many students who have used them all, while no one has a monopoly of all the good points.

OPERATION OF SEPARATOR.

The thoroughness with which the separator does its work depends very much on the speed of the bowl, the temperature of the milk and the flow of milk into the bowl.

Speed.—The handle should be turned steadily, care being taken to keep a constant even pressure upon it, all the way around, not pushing down hard and pulling up hard, while for a moment when the crank is down and again at the top there is no pressure upon it. Turn at the speed the directions call for, or if it is found by testing the skim milk that it is not skimming clean, an increased speed of from three to five turns per minute will usually help matters. The importance of keeping up the speed is shown by the following two experiements.*

*Michigan bulletin 167.

"In the first the power was removed from a machine running at full speed and full capacity separating 600 pounds of milk per hour, and the skim milk caught in small lots and tested separately. The following is the record of the test of the first seven quarts of skim milk coming from the machine after the power was removed.

	per cent fat in skim milk.
1st	.03
2nd	.03
3rd	.045
4th	.05
5th	.10
6th	.12
7th	.16

In the second case a hand separator was turned at different rates of speed, 42 turns of the crank being recommended by the manufacturers. The following are the results.

	Per cent fat in skim milk.
45 turns per minute	.02
42 " " "	.04
39 " " "	.047
36 " " "	.05

Temperature of Milk.—When milk is separted at milking time, unless allowed to stand for some time, it will be at the best temperature for separation and it should be separated then if possible. Cold milk should be warmed up to 80° to 90°. While a can of milk may be set on or near the stove to warm it up, it is better to place it in warm water. When the milk is cold the cream is thicker and if too cold may clog the separator. If necessary to skim cold milk, it will often help matters to adjust the cream screw so as to increase the proportion of cream. As there is usually a large loss in skimming milk too cold, it should be avoided.

Flow of Milk, on most hand separators is fixed by the manufacturers and needs no attention except to see that the faucet does not jar partially shut and that the supply of milk is kept up to the last.

Care.—The separator does not need much oil at a time, but every bearing requiring oil should have some each time the machine is used. Occassionally the bearings should be liberally oiled with kerosene; this will cut out any gum and dirt and help much to keep the machine in an easy running condition.

The relative loss of butter fat in the skim milk from the different methods of securing the cream is as follows:

Dilution method	.7	to	1.	per cent
Shallow pans	.5	to	.7	" "
Deep setting	.2	to	.5	" "
Centrifugal sepaator	.03	to	.05	" "

There will be at least 3,000 pounds of skim milk from a good cow in one year. With the above per cents as a safe basis, one may easily figure the amount of butter fat being lost by the methods he is using. The above figures are for ordinarly good conditions. The losses will be greater when the operator is careless. And on many farms they are greater.

The Michigan Experiment Station secured skim milk from a number of farms and found it contained as high as 1.5% of fat. With average whole milk only testing about 4%, that proportion of loss is very great.

CREAM RIPENING.

Speaking generally the ripening of cream is all of the treatment it receives from the time the milk it drawn until it is churned, while specifically and commonly it is the particular treatment given the cream after separation to prepare it for churning.

The general market wants a butter with a flavor that can only be secured by ripening the cream properly.

Ripening is a souring of the cream. When cream or milk sours the milk sugar is changed to lactic acid, by lactic acid producing germs. The bacteriologist finds that there are several forms of lactic acid producing bacteria; also that some forms of bacteria produce acid without thickening or curdling; others produce the reverse; again some produce gas; while slimy or ropy milk, red, or sometimes called bloody milk are other products of bacterial growth in milk and cream. In general, the changes which occur in milk are due to some form of bacterial life.

Bacteria are minute forms of plant life; they grow rapidly at a temperature of from 60° to 90°; they require food and moisture like higher forms of plant life; they are prevented from growing by cold; are killed by moist heat, most of them by a temprature of boiling water; they may remain inactive for a long time, then grow rapidly when conditions again become favorable; they grow or multiply usually by division, which may happen every twenty minutes, or may require several hours; in the process of their growth they

cause some change in the material in which they are growing. It may be a useful or a harmful one for the dairyman.

The character of the change will be largely determined by the kind of bacteria present, whether from the dust of the air, dusty hay, the flanks of the animal, the seams of imperfectly washed utensils, from a good home made starter or a commercial starter from a pure culture. The change may be retarded by excluding bacteria, by stopping their growth with cold, or by killing with heat. The change may be hastened by introducing bacteria, or by a favorable temperature. The rapidity of the change will depend on numbers of bacteria present and whether the temperature is favorable to their rapid growth or not. In the farm dairy the ripening of the cream is usually brought about by the bacteria which accidentally gain access to the milk and cream, and fortunately for the dairymen the lactic acid germs usually predomniate, esepcially in the clean, well kept dairy.

An understanding of these principles should materially assist in the handling of dairy products to bring about desired or prevent undesirable changes.

The cream should be kept cold, below 50° if possible, until enough is secured for a churning. It should then be warmed up to from 65° to 70° and held until it becomes sour and has a pleasant acid taste; occasionally a little higher temperature may be needed. If the cream was sweet it will usually require 18 to 24 hours to sour it. No cream should be added to that to be churned for at least 12 to 18 hours previous to churning; during this period it should be stirred several times to insure uniform ripeness. When cream of unequal degrees of ripeness is churned, it requires a longer time to churn and there is a much larger loss of butter fat in the butter milk. When a layer of cream is seen on the butter milk that has stood, it is usually due to churning cream too sweet, or part sweet and part ripe cream.

At least two hours before the cream is churned it should be cooled to 50°—56°. If not too ripe it may be held at this low temperature for 12 hours. This cooling will do much to make a firm butter. When it is difficult to secure the desired flavor or when undesirable flavors due to the kind of bacteria which predominate are troublesome, or when under cleanly conditions in very cold weather the cream does not ripen sufficiently or even enough, a starter may be used to advantage.

Starter.—A starter may be sour skim milk or butter milk put in the cream to hasten or control the character of the ripening.

Butter milk may be used when the butter made was of particularly good quality, especially if churnnig every day or every other day. A skim milk or home made starter is usually more desirable.

A home made starter is prepared as follows: Keep separate the milk from one cow, preferably one that has not been in milk long, (the factory butter maker must select the milk of some patron who takes more than ordinaryily good care of his milk); run it through the separator or set in a vessel by itself. Fill one or two fruit jars that have been thoroughly cleansed and scalded, with this skim milk; place these in a pail or other convenient vessel of water at a temperature of 90°. In cold weather it may be necessary to warm the water up once or twice by adding hot water or otherwise. In from 18 to 24 hours, the milk should become nicely loppered, like a soft gelatin, when it is ready to use. If allowed to stand until the curd becomes firm, it will cause particles of curd to appear in the butter. When ready for use it should have a pleasant acid taste, free from objectionable taints and flavors.

In preparing a starter of this kind it is assumed that lactic acid bacteria have gained access to the milk in sufficient numbers that by holding at a favorable temperature for their development they will predominate over the less desirable forms, especially those which thrive at low temperatures. Experience shows this to be true.

A skim milk starter cannot be depended on always. It is wise to prepare two jars and use the best one, or if not right, neither should be used.

Commercial Starters.—Several firms are putting on the market pure cultures of bacteria, known as commercial starters, which have been found to give very satisfactory results in the creamery where large quantities of butter are made and even a slightly increased price for the butter will more than pay for the time and labor required for preparing starters. Under ordinary conditions about 10 to 12 per cent of starter is sufficient, i. e., one quart of starter to two and a half gallons of cream. If the cream gets ripe too quickly use less starter, if too slowly a little more next time. Rules and suggestions for ripening cream are but helps. Conditions vary so from day to day and month to month that only the person who uses judgment and close observation can be sure of the best quality of butter from day to day. It is uniformity of quality and product that holds the trade and commands the higher price.

THE CHURN.

The Kind of churn which has no inside fixture, but dashes the cream from one side or end to the other by the motion of the churn has proved most satisfactory.

The paddles, dashers, etc., of whatever pattern, are apt to hurt more or less the texture of the butter; also cause a loss of butter in the cream, which adheres to them and to the corners of the churn, especially when the cream is a little thick.

When the churning is done in such a short time as is claimed by admirers of many so called improved churns, it is usually at a sacrifice of butter fat left in the butter milk, even though it may not be apparent to the eye.

Wooden churns are to be preferred to metal; because of their getting loose in dry weather if not used frequently or properly taken care of, a steel barrel churn, tinned inside and painted outside, has been put on the market. The objections to it are that the cream warms up more easily when the room is warm and more butter will adhere to it than to the wood. Care must be exercised to wipe it dry or it will rust. On the other hand the cream might be kept in it till enough is secured for a churning, making one less vessel to care for.

The Size of the churn should be such that it will never be filled over half full, and better if only one third full. Where the ordinary churning amounts to from two to five gallons of cream a fifteen gallon churn is a desirable size.

The Speed of a barrel or box churn which revolves should be sufficient to carry the cream to the highest point allowing it to fall the length of the churn. If it is turned too fast the cream will remain in the ends; if too slow it will slip around and churn slowly. The agitation which results from concussion is more desirable than that from friction.

The Time required for churning depends on the ripeness of the cream, the temperature, the fullness of the churn, the amount of agitation and the richness of the cream, and to a lesser extent, period of lactation, and feed. Quick churning usually means large loss of butter in the butter milk. Under ordinary conditions, 20 to 40 minutes is a reasonable length of time for churning and no objection to an hour if firm butter and thorough work are desired, especially if the churning is done with other than hand power.

Temperature.—The only rule which can be given is "churn at as low a temperature as posible and have the butter come in a reasonable time." A high temperature makes quick churning, large loss of butter in the butter milk and soft butter; a low temperature requires a longer time, makes a firmer butter and reduces the loss in the butter milk. While most cream can be satisfactorily churned in 20 to 40 minutes at some temperature between 50 and 60 degrees F., some unusual condition may require a little higher temperature or longer time. In the Experiment Station dairy, 54° to 56° is the usual churning temperature. When gluten meal or feed is fed the

churning temperature may be lowered two to four degrees, while if much cottonseed meal is fed it may be raised a little if the butter is slow in coming.

The variations in the churnability of cream from different cows, and herds, from the same cows at different seasons of the year, and varying stages of lactation require some variation in the churning temperature. Use a thermometer; then if the butter comes quick and soft lower the temperature of the cream next time. It is very desirable that the cream be held at the churning temperature for at least two hours previous to churning. The butter will be firmer if this is done. No objection to its standing longer if the cream is not over ripe.

Difficult Churning.—In the winter when the cows are on dry feed and have been milking for nearly a year or more and give only a small amount of milk, it is frequently difficult to make the butter gather.

Skim as thick a cream as possible; ripen the cream as described elsewhere till there is a pronounced acid flavor; do not fill a barrel over one third full and churn at a little higher temperature.

Color.—If selling butter to the general market, use color if necessary to make the butter about the color of June butter. For private trade, color or not, as suits the customers. The standard butter colors are harmless and tasteless in the quantity needed. The amount required is small and can only be determined by trial. As the color combines only with the fat, a rich cream will require more color per gallon of cream than a thin cream. The color should be added to the cream just before starting the churning.

Stopping.—Stop the churning when the granules of butter are about the size of wheat grains, float freely, standing partly out of the butter milk and separate readily from it.

If the butter comes very soft, cold water may be added when the butter begins to break. When the granules form small and refuse to "gather" and separate from the butter milk, a little strong brine made by dissolving dairy salt in cold water will usually help the separation of the butter from the butter milk. A little salt may be thrown into the churning, but it is better to use the brine. Of course much of it will spoil the buttermilk for drinking or cooking.

Straining.—In drawing the butter milk from the churn it is well to strain it through a cheese cloth or hair strainer, which will catch the crumbs of butter that may otherwise be lost.

Washing Butter.—By washing the butter while still in the churn with about as much cold water as there was butter milk or a little more, the buttermilk may be very thoroughly removed.

The washing removes the casein, curd, of the butter milk.

The casein which may be left in the butter, spoils very quickly, hence it is desirable to have as little of it in the butter as possible.

A second washing may be required. Excessive washing should be avoided as it may injure the flavor of the butter. The temperature of the wash water should be a little, three or four degrees, below the churning temperature. If wash water is very cold, the outside of the butter granules are hardened while the inside remains soft, so that when salt is added it will not be evenly mixed through the hard and soft butter by the working. This uneven distribution of salt will cause mottled or streaked color in the finished butter.

Salting—Only the best grades of dairy salt should be used for butter. It may be added as a brine after washing the butter. This method wastes a good deal of salt and is only desirable where a very mildly salted butter is wanted.

The salt may be sprinkled on the butter while it is yet in the churn, then revolve the churn a few times till the butter is partially gathered, and allow it to stand if convenient, for an hour or two, so the salt may become thoroughly dissolved, and finish working either by revolving in the churn or taking it out.

The butter may be removed from the churn while in the granular form; spread on the worker, and the salt sprinkled over it. Work a little to incorporate the salt and possibly allow it to stand a little while till the salt dissolves; then finish the working.

The amount of salt used must be determined by the demands of the market. For the general market one ounce of salt for each pound of unworked butter is about right. The main thing is to learn what the market wants and then adopt a method which will give uniform results. If it is not convenient to weigh butter and salt, use a small measure of salt for a certain number of gallons of cream. For hand separator cream this method will give quite uniform results.

Working.—The butter is worked to expel the surplus moisture, to incorporate the salt and to give the butter a compact body. Overworking injures the texture and makes the butter appear greasy. When possible, it is desirable to work the butter a little and then allow it to stand for a couple of hours or until next day; then finish. If there is not a suitable place to keep the butter in between workings, it is better to finish it right up. The working should be stopped when the butter breaks, with a slight tendency to hold together or string out in short pin points. As soon as it passes the stage where it breaks with a clean break, stop working. More butter is injured by overworking than by insufficient working.

Package.—The package should suit the market. Pound prints

(standard size $2\frac{1}{2} \times 2\frac{3}{8} \times 4\frac{5}{8}$ inches) are gaining in public favor very rapidly and are a convenient form for packing, for handling and for table use. Wrapped in first class parchment paper and placed in a manilla wrapper, called cartons, good butter will command a fair price and in most markets, a cent or more above that which is equally good packed in jars or irregular packages.

If prints are to be packed in boxes immediately it will usually be better to wrap them in dry paper, while if they are to be handled or allowed to stand, the paper will stay in shape better if dipped in cold water before wrapping.

Do not use wax paper for butter. A strong dairy parchment paper is the best for the purpose.

Marketing.—Private customers who will contract for a regular supply at a fixed price are usually the highest price market available to the maker of first class dairy butter, as the express charges, commission etc., on comparatively small lots are too high to warrant shipping. While private customers pay the highest price for good butter regularly supplied, the time required in delivery and collections is considerable. Frequently a grocer who has the best class of trade will contract for all of the butter at a fair price. Uniform quality from week to week and regularity of delivery are essential if fancy prices are secured.

WEIGHING AND TESTING MILK.

One of the most important things which may be done to increase the profit from the milch cows kept on the farm is to know accurately how much milk and butter they are producing annually. Each one must be fed a year no matter whether it is grain or pasture, and she should produce enough over and above cost of care and feed to make a reasonable profit.

While it may pay to weigh the milk of each cow at each milking, especially with pure bred dairy cows, it is often impracticable to do this, but it will pay every farmer to weigh the milk one morning and one night each month throughout the year and multiply this by the number of days in the month, and use this as a basis for estimating the year's production. Careful experiments show that this method will give reasonably close results. It has been repeatedly shown that even the person who is milking the cows cannot determine the relative amount of milk or butter produced by the several cows in a herd without the aid of the scales and tester.

When the milk is made into butter or sold on the basis of the butter fat, a Babcock test should be used and an estimate of the

yearly fat production secured. This may be done as follows: At the milkings, when the weighing is done, have a pint fruit jar or other convenient vessel for each cow that is to be tested. After weighing the milk, pour from one pail to another at least twice. The first milk drawn from the cow is very poor in butter fat, often testing as low as 1.5%, while the last is very rich; the last pint or two may test as high as eight or nine per cent. In order to get a fair test it must be thoroughly mixed as described. A sample taken during the milking will not be a fair one. After thoroughly mixing, place a little in the jar, say three or four tablespoonfuls, at the second milking, add about as much more. From this mixed sample the small amount required for testing may be taken.

Directions for operating the test usually accompany the machine, only some suggestions are here given which may be useful. Any bright boy or girl, 14 or 15 years old, can learn to operate the test accurately with a little practice.

Mixing Samples.—Samples should be mixed by pouring from one vessel to another, immediately before they are measured with the pipette. Shaking the sample will some times churn parts of the butter, especially if the sample has been warmed up. Pouring is the best way.

When lumps of cream are not broken up by pouring and the milk is not curdled, it will often help matters to warm the sample by placing the jar of milk in warm water a few minutes.

Composite Samples may be taken when it is desired to test all of the milk produced in a week or two, but do not want to test each milking separately. They should be used at the creamery for determining the amount of fat brought by each patron. Taken as follows: Into a jar which has a tight cover, put a corrosive sublimate tablet, or small quantity of bichromate of potasium, and each day add a small amount of milk. Care should be taken to see that the new milk and any cream adhering to the sides of the vessel are thoroughly mixed by rotating rather than by shaking the jar.

At the end of the desired period test this composite sample in the usual way, with the pounds milk given during the period covered by the sample, and the per cent. of fat given by the test, the pounds of fat produced are easily determined.

In creamery practice, if the composite sample has not kept properly it can often be dissolved by putting a very little common lye into the sample when ready to test, and allow it to stand a short time, shaking it occasionally.

Test not Clear, may be due to too strong acid, in which case use less of it, or allowing the milk and acid to stand before mixing. Particles of cork in the acid may do it. If acid is weak there will

be a light deposit below the fat column; it may be avoided by using more acid.

Reading should be done from the lowest part of the bottom curve of the fat column to the point where the upper curve of the fat touches the glass. A pair of dividers may be used in reading. Spread the points as far apart as the length of the fat columns; then place the lower one on the zero mark, and the upper point shows the reading.

The following causes and effects are met with in the dairy:

SEPARATING.

Causes.	Effects.
Irregular inflow Vibration of bowl Irregular speed Cold milk	Large loss
Increased flow Insufficient speed	Thin cream
Small cream exit Increased speed Reduced inflow	Thick cream
Uniform speed Sufficient speed Proper temperature	Small loss
Sour milk Too rich cream Cold milk	Clogging
Skims cleanest Smallest bowl Slowest speed Fewest parts Skim at lowest temperature Best workmanship Easiest adjusted Lightest running Easiest cleaned	Best separator

CHURNING.

Causes.	Effects.
Gluten feeds Oil meal High temperature	Soft Butter
Cream of unequal ripeness High temperature Thin cream Sweet cream	Large loss in the butter milk
Low temperature Ripe cream Evenly ripe Rich cream	Small loss
Low temperature Very thin cream Very thick cream Sweet cream Churn too full Slow agitation Cream from stripper cows. Cream of unequal ripeness	Slow churning
Cream exposed to odors Over ripe cream Decaying feed Moldy feed Impure drinking water Stable odors Sick cows	Impaired flavor
Over ripe cream Dried cream Foreign matter	Specks in butter
Uneven temperature Uneven salting Insufficient working Sudden chilling Change of temperature	Mottles and streaks
Over working Over heating Over churning Slipping of tools in working	Texture injured
Thin cream Sweet cream Churn too full Cold cream Advanced period of lactation	Difficult churning

Causes.	Effects.
Succulent feeds	Higher colored butter
Summer feeds	Higher colored butter
Cotton seed meal	Light colored butter
Cotton seed meal	Hard butter
Bran	Hard butter
Legumes	Hard butter

TESTING.

Too warm milk	Chars fat
Too strong acid	Chars fat
Insufficient mixing	Dark sediment
Foreign matter	Dark sediment
Cold milk	White fat
Cold acid	White fat
Weak acid	White sediment and light colored fat.
Insufficient speed (tester)	Low reading
Too cold	Low reading
Delay in reading	Low reading
Broken pipette	Low reading
Too hot	High reading
Unclean bottle	High reading
Unclean pipette	High reading
Sample by weight	Cream
More acid	For Skim Milk
Higher speed	For Skim Milk
More heat	For Butter Milk
Double neck bottle	For Butter Milk
Maintains uniform temperature	Best tester
Maintains uniform speed	Best tester
Easiest controlled	Best tester
Breaks fewest bottles	Best tester
Does not tremble	Best tester
Easiest balanced	Best tester
Has top and bottom bearing	Best tester

MISCELLANEOUS DATA.

Temperatures:

Milk when drawn	98°
for shallow setting	60°
deep setting	40° to 45°
seperating	85° to 95°
ripening cream	65° to 75°
Churning	50° to 60°
Milk for city delivery	45° to 50°
Milk for calf feeding	95° to 100°
Reading test bottles	120° to 140°
Skim milk starter set at	90°

Keep above 75°; if necessary warm up after 6 to 10 hours.

Time:

For cream to rise

in shallow pans	24 to 36 hours
in deep setting	12 to 24 hours
cream to ripen	18 to 24 hours
churning ripe cream	20 to 40 minutes
First whirling of test bottles	5 minutes at full speed
Second and third whirling of test bottles	1 to 2 minutes

Per cent. of fat.

Average milk	3.7%
Guernsey	5.0%
Jersey	5.0%
Shorthorn	4.1%
Ayshire	3.7%
Holstein	3.0%
First milk drawn	0.8 to 2%
Last milk drawn	5.0 to 12%
Rich cream	35.0 to 50%
Commercial cream	20.0 to 25%
Butter	83.0 to 88%

Loss of fat should not be over

In dilution skim milk	.7 to 1.%
Shallow pan skim milk	.5 to .7 %
Deep setting skim milk	.2 to .5 %
Separator skim milk	.03 to .05 %
Butter milk	.1 to .2 %

FERTILIZING MATERIAL REMOVED IN FARM PRODUCTS.

The following figures are presented to emphasize the reason why it is desirabble to feed on the farm the crops that are grown upon it, and sell only live stock and dairy products, thus removing from the farm the minimum amount of valuable fertilizer elements and eventually returning to the land the major portion of the manure, solid and liquid, if properly take care of.

The purchase of concentrated feeds, bran, linseed, cottonseed and gluten meals, brings onto the farm from $10.00 to $12.00 worth of these same valuable elements per ton of feed, about three-fourths of which goes into the manure.

An understanding of these facts suggests why dairying is one of the surest and quickest means of building up and maintaining the soils which have been depleted by continuous cropping.

To estimate the value of commercial fertilizers, the State Chemist values nitrogen at 15c per lb., phosphoric acid 3½c., and potash 6c. per lb. These prices with table III in "Feeds and Feeding" as a basis for the fertilizer elements in the common farm products show that $100 worth of the various farm products will contain nitrogen, phosphoric acid and potash worth as follows:

Product..		Market price.	Value of fertilizing material in $100 worth of products.
Roughness			
Oat straw	at	$3.50 per ton	$99.65
Corn stover	at	4.00 per ton	97.47
Wheat straw	at	3.00 per ton	82.20
Timothy hay	at	8.00 per ton	65.39
Grains			
Corn	at	.35 per bu.	64.30
Oats	at	.20 per bu.	59.98
Wheat	at	.60 per bu.	41.16
Barley	at	.40 per bu.	33.95
Live Stock			
Sheep	at	3.00 per 100 lb.	11.44
Cattle	at	4.00 per 100 lb.	10.41
Wool—unwashed	at	.20 per lb.	6.69
Hogs	at	4.50 per 100 lb.	6.59
Dairy Products			
Milk	at	.90 per 100 lb.	10.72
Cheese	at	.10 per lb.	6.82
Cream	at	.48 per gallon	1.05
Butter	at	.20 per lb.	.11

If the market price is higher than given above it will take less of the product to make $100.00 worth, consequently the loss of fertility will be less in each $100.00 worth. If prices are lower the loss will be greater.

GENERAL INFORMATION.

The following helps are available for the person who wants to learn more about the production, care and handling of cows and dairy products:

Books.

Most any Agricultural paper will send the following on receipt of price:

Milk and Its Products, Wing $1.00
Outlines of Dairy Bacteriology, Russel 1.00
Testing Milk and Its Products, Farrington and Woll 1.00
Creamery Patrons Handbook 1.00
Feeds and Feeding, Henry 2.00
Feeding Farm Animals, Jordan 1.50

Dairy Papers.

Hoard's Dairyman, Ft. Atkinson, Wis., Weekly..... $1.00
Dairy and Creamery, Chicago, Semi-Monthly ..... .50
Kimball's Dairy Farmer, Waterloo, Iowa, Semi-Monthly... 1.00

Creamery Papers.

Chicago Dairy Produce, Chicago, Ill., Weekly 1.50
New York Produce Review, New York, Weekly 1.00
Creamery Journal, Waterloo, Iowa, Monthly 1.00

Institutions.

Purdue University, School of Agriculture, LaFayette, Ind.

Four years' course in Agriculture.

Ten weeks' course in Farm Dairying.

Ten weeks' course in Creamery Butter Making.

Ten days' course in Commercial Starters and Cream ripening.

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DESCRIPTION OF CUTS.

Cut 3—A useful strainer which can be made by any tinner. Diameter of top 10 inches, of bottom 5 inches, total height 7 inches. The rings are slipped on after the cheese cloth is in place, and are removed for washing. The left figure shows the strainer complete, the other with the cloth removed for washing. There is no wire strainer in it, only cloth top and bottom. The top cloth should be large and sag down to prevent spilling when pouring into it. New cheese cloth should be secured occasionally. After using the cloth should be rinsed in cold water, washed clean in warm water, scalded and hung in the sunshine.

Cut 4—A swing churn—a barrel churn and a lever butter worker. Either churn is very satisfactory, will do thorough work in a reasonable length of time, if not filled too full and the cream is right. More depends on the condition of the cream than on the churn. A butter worker is a great labor saver for the farm butter maker, and is less apt to injure the texture than working in a bowl with a ladle.

Cut 5—Butter wrapped in parchment paper after being printed with a printer like the one in the left center. The printer may be carved so as to show a figure or initials on the butter. At the right is shown a cheap printer. In the right center a Gem paper package into which butter may be packed as into a jar. At the extreme left are a closed and an open butter carton, made of a special parafined card board for wrapping prints in.

Cut 6.—Two styles of Babcock testers, with glassware complete; also two small balances for weighing cream when testing.

In front of the tray in which the bottles are resting is a common tin cup with a small spout for filling the bottles with hot water.

Cut 7—Shows the different bottles used in testing skim milk and cream. The left hand bottle is a "doubble neck skim milk bottle." The graduations on the small neck represent five one-hundredths of one per cent. (.05%) of butter fat. The bottle shown contained only one space of fat.

The second, third and fourth bottles are whole milk bottles, the graduations being 0 to 10 per cent., subdivided into two-tenths spaces. The third bottle shows a fat column extending from 3.4 to 9.2 or 5.8 per cent. of fat, while the fourth shows 3.7 to 7.7 or four per cent. of fat. The right hand two are cream bottles, graduated in per cent., subdivided into half per cent., the first showing a fat column, extending from 3.5 to 25. or 21.5 per cent. of fat, while the last shows very indistinctly 19 per cent.

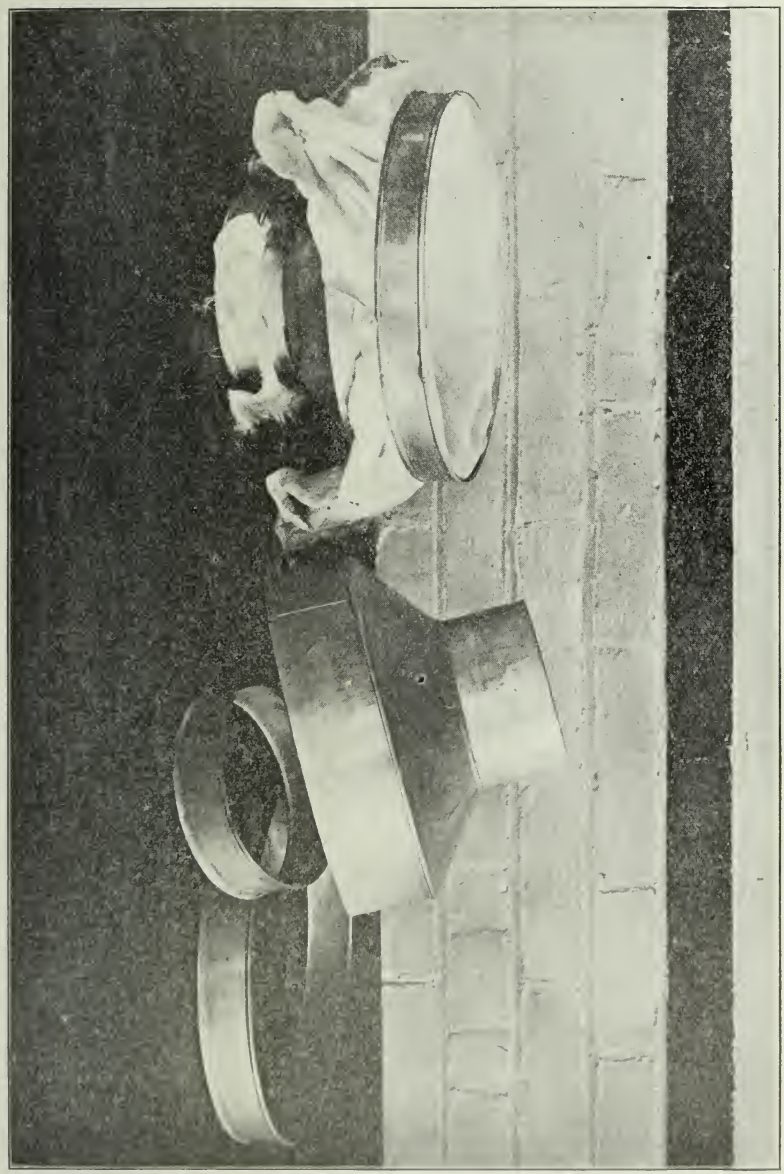
Chart eight shows the variation in the amount of milk, the per cent. and the pounds of fat from day to day, for two cows in the college herd, during the first four weeks in May, 1903.

Some lessons to be drawn from it are:

1st—That there are great variations not only in the amount of milk given and the amount of fat contained in it in one day, but in the proportion, or per cent. of fat in the milk. For instance, (see "Purdue's Primrose") on the 18th there was a marked falling off in yield of milk from nearly 16 to less than 14 pounds, while the per cent. of fat and the actual amount of fat increased. On the 22nd, the reverse was true, the milk going up and the test and the amount of fat for the day falling off. On the 8th there was an increase in all three, while on the 17th there was a decrease.

2nd—That there is a very noticeable difference in the amount of variation with different cows, even though kept under similar conditions. A comparison of the line used to indicate the yields and per cents. for the two cows will show this. "Purdue's Primrose" has for several years shown marked variations from day to day and milking to milking, while "Purdue's Golden Primrose's record is very much more uniform from day to day.

3rd—The most marked changes did not occur on the same day, as a rule, with both cows, suggesting that the causes were individual. However, the evidence submitted here is meant to be suggestive rather than conclusive, as an argument for more records and accurate knowledge on the part of the owner of what his cows are actually doing, and suggesting why it is necessary to test frequently and regularly if accurate information is desired.



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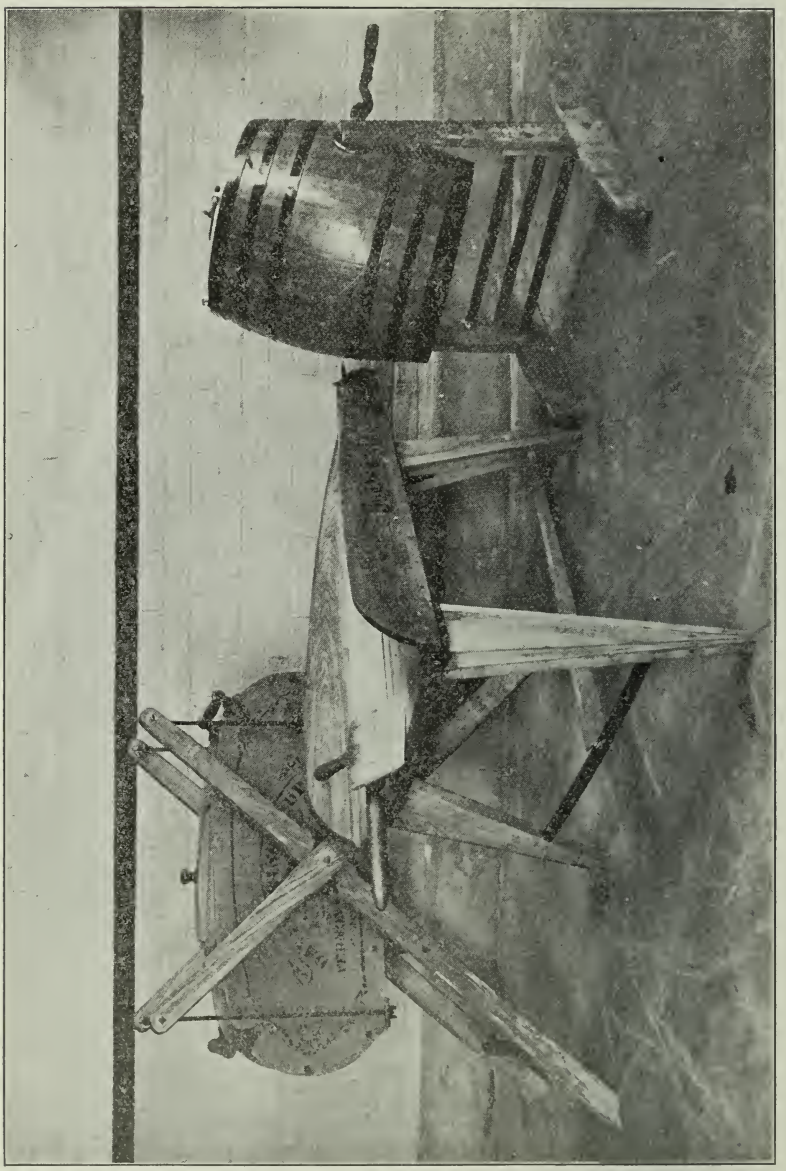

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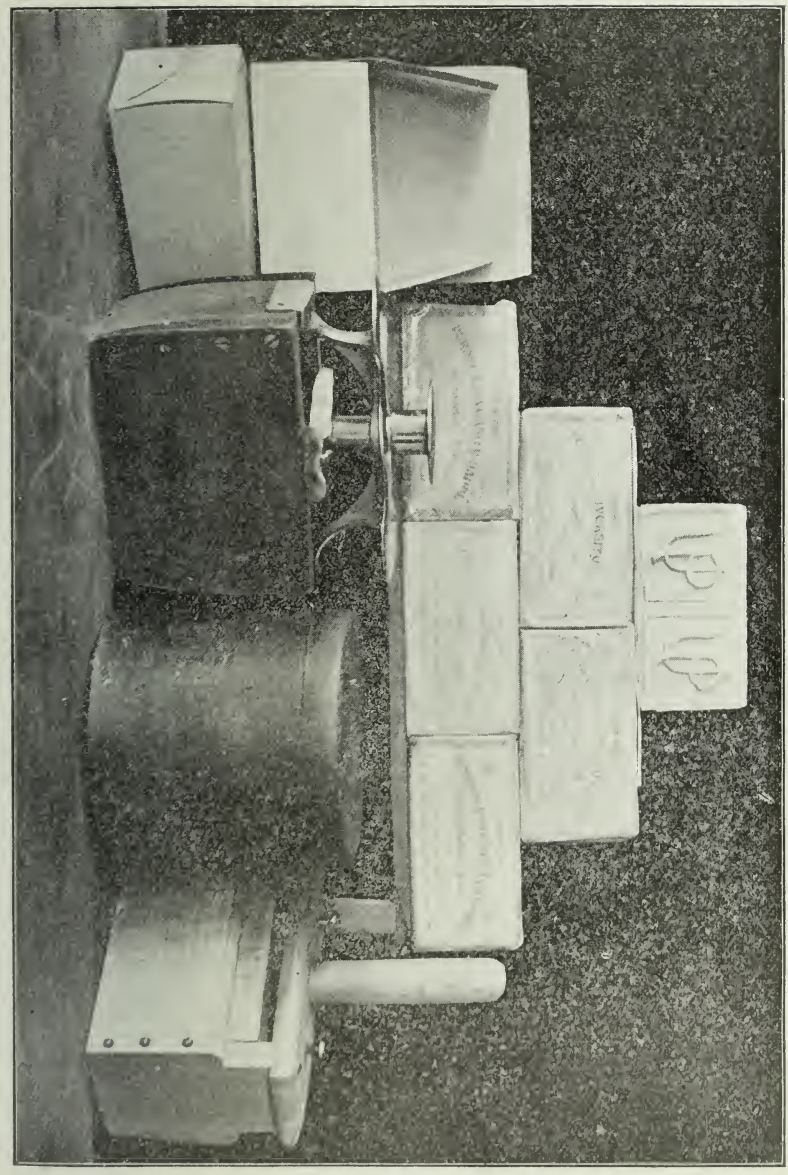

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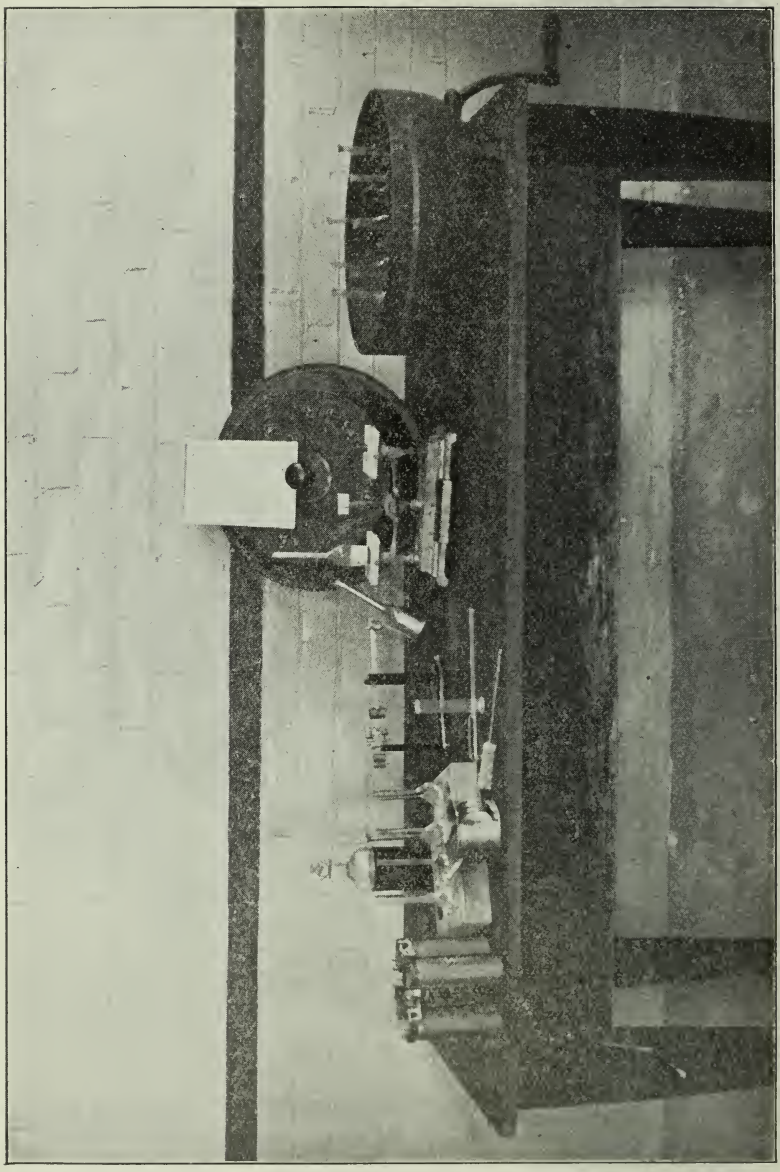

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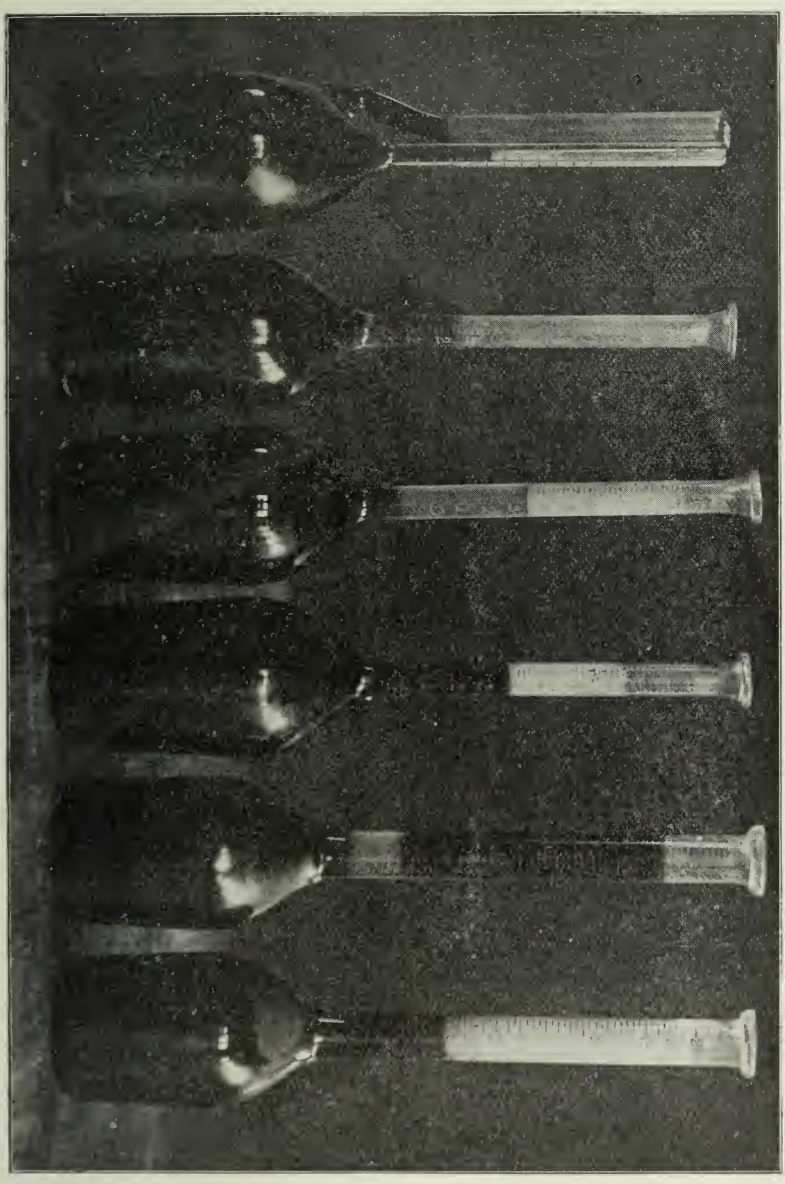

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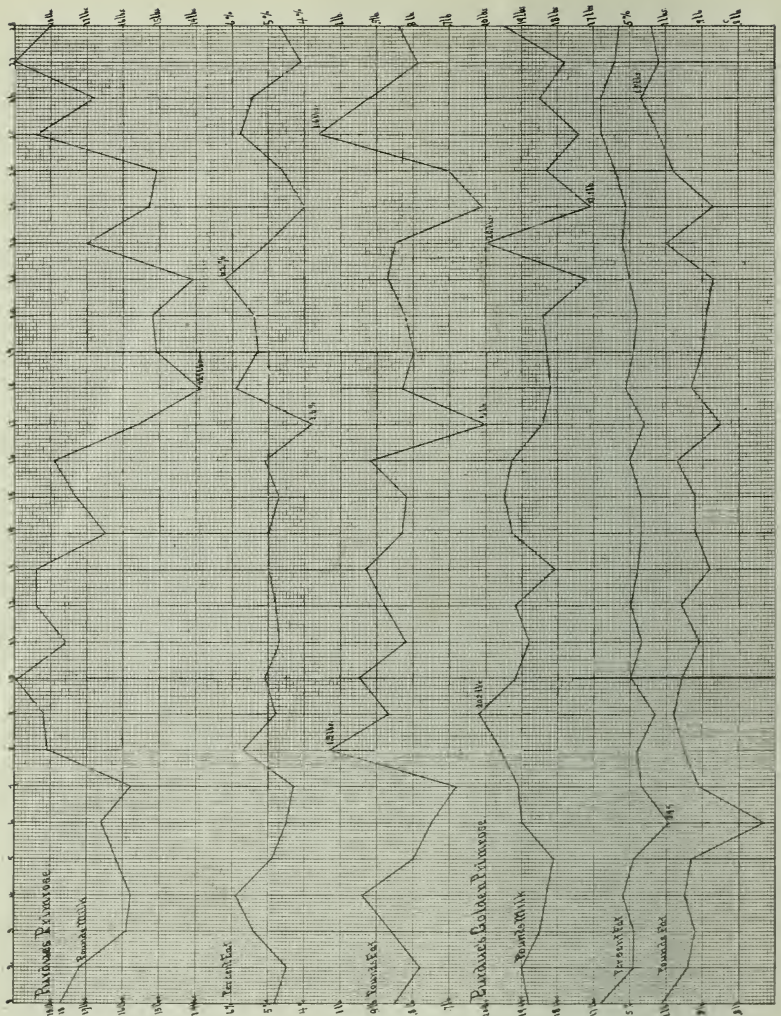

No. 8.

Purdue University

Agricultural Experiment Station

BULLETIN NO. 97, VOL. XII.
OCTOBER, 1903.

On the Value of Distillery Dried Grains As a Food for Work Horses.

Published by the Station:
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On the Value of Distillery Dried Grains as a Food for Work Horses.

BY C. S. PLUMB.*

In a very general way, the grain foods fed horses in the Eastern and Central Western States consist of oats or corn and oats. To be sure bran mashes or dry bran are often used, but these are fed usually as correctives, to promote an active condition of the digestive organs. The value of oats as a feed for horses has long been recognized. They not only contain a fairly large per cent of protein or muscle making food, but they are generally recognized as possessing a characteristic which promotes energy and vivacity in the horse as in no other farm animal. A study of the rations fed horses in the large stables. both of America and Europe, where thousands of animals are concerned, will show oats more frequently in evidence than any other grain. Corn is an extremely palatable grain for all farm animals, but its greatest value lies in its fattening quality. It is the principal grain made use of by men who make a special business in fattening draft horses to be sold on the market. In the leading horse markets of the Middle West, weight counts much in selling value, and nothing will produce this better than corn. In these markets it is considered that each additional pound of live weight laid on, is worth 25 cents in selling on the draft horse market. Corn fed animals are smoother than oat fed ones, but they are also softer in flesh and lack the staying qualities required, where corn only is used.

In a consideration of a wider range of concentrated feed stuffs for the horse, the writer's attention was directed to the use of distillery dried grains as a source of feeding material of high muscle making power, these containing 25 or more per cent. of digestible protein. In the past it has served as an ex-

*Director of this Agricultural Experiment Station until July 1, 1903, when he resigned to accept another situation elsewhere.

ample, also, of a food rich in protein selling at a low price on the market. This was due mainly to the slight extent to which it was known by the purchasing public.

In the report on the following feeding experiments with horses, Mr. H. E. Van Norman, who was in 1900 Farm Superintendent and Station Assistant, personally attended the feeding of the mares that year, while in 1902 Mr. R. C. Obrecht, Farm Superintendent and Assistant, gave similar attention to the feeding. These gentlemen gave careful attention to the feeding, and made numerous notes from time to time on the relationship of the food to appetite, digestion, animal condition and work.

In the year 1900 a quantity of what are known as "Biles Fourex" distillery dried grains with a guaranteed manufacturers 33 per cent. protein, were secured by this Station. They were rather strong in flavor, and when offered to cattle were not generally relished by them. In order to note their suitability and economy as a food for horses, four medium weight mares on the Station farm were placed in a feeding experiment, with these grains as a part of the ration. There were two teams, and in making up the lots for feeding, two mares in one team received dried grains and the other team did not. After feeding Polly and Maud dried grains four weeks, the feeding was reversed, and Clara and Topsy were given oats and distillery grains, and Polly and Maud fed oats. During the last three weeks of the experiment the grains were again fed Polly and Maud, and only oats fed Clara and Topsy. This experiment continued from June 27 to Sept. 12, and involved the usual run of farm work, including haying, harvesting, cultivating corn, plowing and fitting wheat land and doing miscellaneous work. The mares were weighed from week to week, and a careful record was kept of the amount of food fed at each feeding time to each horse, with notes as to the effect of the distillery grains on the appetite, on the digestion, on bodily condition and on capacity to work.

Table I shows the amount of food of each kind that was fed each horse per week during the experiment.

It will be noticed that this table shows a great difference in the amount of distillery grains eaten by each mare. Polly and Maud never ate their grain with relish so long as the distillery grains formed a part of it. On several days they would eat none at all. Polly had more of an aversion for it than Maud, especially when its use was commenced. Clara and Topsy however, ate it with more freedom and less aversion, eating it in fairly large amounts. Neither Polly nor Maud ate

TABLE I.

Total Feed Eaten Per Horse Per Week.—Lbs.

DATE	POLLY			MAUD			CLARA			TOPSY		
1900	Oats.....	Distillery Grains..	Hay.....	Oats.....	Distillery Grains.	Hay.....	Oats.....	Distillery Grains	ay.....	Oats	Distillery Grains.	Hay.....
June 27-July 4	60.	2.51	89.	61.	7.73	84.	89.75	.....	89.	91.	.....	89.
July 4-11.....	80 5	4.37	96.	80.	7.06	84.	.	.....	93.	86.	.....	90.
July 11-18.....	84.	9.15	92.88	84.	8.06	88.56	84.	.....	93.	84.	....	92.37
July 18-25..	102	9.06	102.	84.	9.87	92.25	84.	.....	95.	84.	.....	95.
July 25-Aug. 1.	105.	.....	100.	84.	...	93.	84.	12.5	93.	84.	12.5	93.
Aug. 1-8 .	105.		104.	84.	.....	90.75	59.25	24.25	89.	58.75	24.75	91.75
Aug. 8-15.....	105.	.....	104.	84.	.....	87.	52.5	42	91.	52.5	44.87	89.
Aug. 15-22.....	100.	.....	112.	84.		96.	52.5	42.	96.	50.	50.	91.
Aug 22-29..	94 5	5.75	103.	73.5	6.25	93.	84.	.....	103.	84.	.....	93.
Aug. 29-Sept 5	105.	6.5	101.	84.	7.25	91.5	104.	.....	101.	84.	....	90.
Sept 5-11	95.	4.75	80.	76.	4.75	79.5	95.	.....	92.5	76.	.....	75.
Total.....	1036	42.09	1083.88	878.5	50 97	979.56	876.	120.75	1045.5	834.25	132.12	989.12
Average ..	94.1	.....	98 53	79.86	..	89.05	79.63	.....	95.04	75.84	.....	89.91
Average ..	.....	6.01	.....	.....	7.28	.....	..	30.18	.....	.....	33.03	.....

a full ten pounds in a week, while Clara ate as high as 42 pounds and Topsy up to 50 pounds. With each mare however, it was necessary to teach them to eat the grains, adding them in increasing amounts to their oats, as they would consume them.

One is naturally interested in learning the influence of this food on live weight during the continuance of the experiment. Table II gives the weight of each mare from week to week. The dark figured type is for the weeks the mares received the distillery dried grains.

TABLE II.
Weights of Mares.

	LOT I		LOT II	
DATE	Distillery Grains and Oats		Oats Only	
1900	POLLY	MAUD	CLARA	TOPSY
June 27	1217 lbs.	1096 lbs.	1258 lbs.	1095 lbs.
July 4	1150 lbs.	1164 lbs.	1239 lbs.	1054 lbs.
July 11	1162 lbs.	1155 lbs.	1236 lbs.	1050 lbs.
July 18	1146 lbs.	1182 lbs.	1248 lbs.	1050 lbs.
July 25	1183 lbs.	1183 lbs.	1245 lbs.	1060 lbs.
Aug. 1	1184 lbs.	1185 lbs.	1246 lbs.	1075 lbs.
Aug. 8	1154 lbs.	1173 lbs.	1230 lbs.	1045 lbs.
Aug. 15	1175 lbs.	1142 lbs.	1200 lbs.	1027 lbs.
Aug. 22	1183 lbs.	1143 lbs.	1230 lbs.	1065 lbs.
Aug. 29	1168 lbs.	1121 lbs.	1228 lbs.	1055 lbs.
Sept. 5	1202 lbs.	1133 lbs.	1236 lbs.	1040 lbs.
Sept. 12	1175 lbs.	1122 lbs.	1240 lbs.	1015 lbs.

This table would on reasonable examination impress one with the fact that feed played but little part in weight variations. In fact there are no variations which show great losses in weight, for some allowance must be made for the influence of contents of stomach and intestines on weekly variations in weight. As a matter of comparison, however, the following table has been prepared, which shows the average weight of each mare for the periods fed distillery grains and for those where only oats were fed.

TABLE III.
Average Weights of Mares When Fed.

	Distillery dried grains.	Oats only.
Polly	1169.4 lbs.	1174. lbs.
Maud	1151.4 lbs.	1160.7 lbs.
Clara	1226.5 lbs.	1238.8 lbs.
Topsy	1053. lbs.	1046.2 lbs.

In this table, each mare shows a slightly greater average weight during oat feeding than when distillery grains were used, excepting Polly, which weighed an average of 6.8 lbs. more while fed the grains.

In 1902, when feeding materials were especially high in price, another experiment was inaugurated to see if the dried

distillery grains could not be used satisfactorily in the feeding rations of horses.

As in the 1900 experiment, four mares were used, of which two, Topsy and Poliy were in the former test. Belle and Fancy were five-year old high grade Clydesdale mares, while Topsy and Polly were of unknown breeding, and of common farm type. Differing from the preceding experiment, this one included shelled corn in the ration. It began on March 21 and continued to May 6, thus including some of the harder plowing work of the year, and involved much labor in fitting land for summer crops.

Table IV which follows, shows the amount in pounds of corn, oats, distillery grains and hay fed each mare per week.

TABLE IV.

Foods Fed Mares Per Week in Pounds.

	LOT I								LOT II							
1902 -	TOPSY				BELLE				FANCY				POLLY			
WEEK	Corn	Oats	Distillery Grains	Hay	Corn	Oats	Distillery Grains	Hay	Corn	Oats	Distillery Grains	Hay	Corn	Oats	Distillery Grains	Hay
Mar. 21-Apr. 1	52.5	63.	.....	96.5	52.5	72.	.....	139.87	50.	49.	18.5	130.5	50.5	49.5	7.	127.37
Apr. 2-8	52.5	73.5	.....	97.	52.5	84.	.....	125.5	52.5	52.5	25.25	122.75	52 5	52.5	6.75	125.75
Apr. 9-15	52.5	45.5	29.	97.25	52.5	53.	29.5	127.75	52.5	82.5	.....	124.	52.5	81.5	.....	124.5
Apr. 16-22	52.5	9.	63.75	98.25	52.5	15.5	63.	134.	52.5	84.	....	132.75	52.5	84.	.....	126.25
Apr. 23-29	52.5	6.5	65.5	100.	52.5	7.	74.	139.75	52.	84.	....	137.25	52.5	82.	.....	124.25
Apr. 30-May 6	69.5	1 5	46.	110.	69.5	1 5	52.5	137.25	69.5	58.5	.....	136.	64.5	47.	....	128.
Total	332.	199.	204.25	599.	332.	233.	219	804.13	329	410.5	43.75	783.25	325.	396.5	13.75	756.13
Average	55.3	33.1	.....	99.8	55.3	38.8	....	134.02	54.8	68.4	....	130.5	54.1	66.	....	126.
Average		.....	51.06	.....	....	....	54.7	.....	....	.....	21.87	.....	....	..	6.87	.....

This table shows, as in the previous feeding experiment, that Polly did not eat distillery dried grains at all well. In fact, until April 4, she did not once eat all that were fed her at any one feed. For the first week she averaged just a pound a day, and the second week slightly less. Fancy ate with better appetite, but neither of these mares did at all well on this feed. On the other hand Topsy and Belle ate the grains fairly well in

greater degree. On account of the poor manner in which her grain was eaten, with falling off in general appearance, it was deemed wise to discontinue feeding the distillery grains to Fancy and Polly. They were however, fed to Topsy and Belle for four weeks, with fairly satisfactory results, after which their use was discontinued.

Table V. shows the weekly weight of each.

Weights of Mares—Pounds.

	LOT I		LOT II	
DATE—1902	Topsy	Belle	Fancy	Polly
March 25	1210	1325	1345	1345
March 26	1210	1335	1355	1345
March 27	1195	1340	1350	1340
Average for March 26	1205	1333	1350	1343
April 2	1170	1300	1290	1315
April 9	1170	1295	1280	1310
April 16	1190	1275	1190	1340
April 23	1180	1245	1295	1345
April 30	1220	1275	1335	1385
May 7	1210	1235	1290	1340

None of the mares fell off appreciably in weight during the experiment, although undoubtedly Polly would have had the grains been continued to her. Enough other food was given to keep the animals up to their work, and at no time would they have eaten enough of the dried grains to have demonstrated that they were palatable and relished by them.

Had this material in the judgment of those feeding it, seemed to furnish a satisfactory addition to our concentrates for horses, then its cost would be an important factor in its adoption and use. However, inasmuch as two years experience seemed to demonstrate that it was lacking in palatability as a horse food for common use, to which the teamsters emphatically agree, it would appear useless to give attention to the cost of this material as a food for horses. While without question "Biles Fourex" grains possess high feeding value, as based on chemical analysis, our feeding simply illustrates the special importance of palatability as a factor in the adoption of food stuffs for use in common practice.

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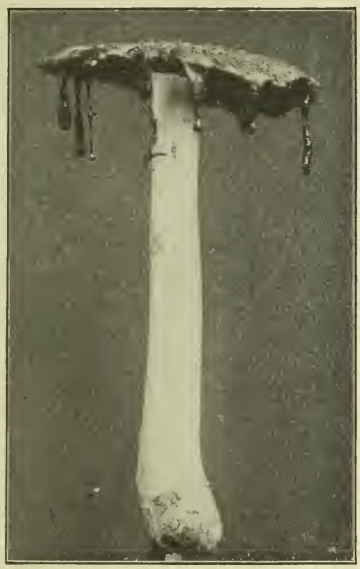
Agricultural Experiment Station



Bulletin No. 98. Vol. XII.
February, 1904.

Three Edible Toadstools.

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Three Edible Toadstools.

BY J. C. ARTHUR.

The use of mushrooms as an article of diet would become common among all classes doubtless were it not for the fatal poison that lurks in some of the species. On account of this deterrent fact to know that many pounds of most acceptable and nutritious food is annually available to nearly every family, except to the dwellers in crowded parts of large cities, does not materially tend toward increased consumption. Even to know that not more than a half dozen kinds are dangerous, out of the hundreds to be found in almost any region, inspires slight confidence. No one cares to take the one chance in a hundred of losing his life for the sake of an occasional addition to the daily menu, however delicious the added dish may be. The wiseacre who would tell the good from the bad by the action of a silver spoon, change of color upon breaking, ease in peeling, pungency of taste, or some other equally simple test, is wholly discredited now-a-days, and very properly so. The person who divides all fleshy fungi into mushrooms, which are therefore edible, and toadstools, which are therefore poisonous, does not know the rudiments of the subject of mycophagy.

To begin with, there is no difference between mushrooms and toadstools. The names are applied interchangeably according to personal fancy, or local custom. There appears to be a tendency in most usage, however, to limit the term toadstool to the more fragile and highly perishable sorts, and I have, consequently, used the word in the title of this bulletin, as I propose to describe three closely related forms that last but a day, usually turning to ink before the sun goes down.

Again, there is no convenient test by which to tell the good from the bad, except the test of individual recognition. If one goes to the fields to gather berries, he must know which are blueberries, raspberries, etc., and not be putting into his basket the deadly nightshade, and other poisonous fruits, however attractive they appear.

In the days of reconstruction after the civil war a common saying was that the way to resume specie payment was to resume. And so one may say that the way to learn the edible fungi is to learn. Become perfectly familiar with one kind at a time as opportunity favors, either through the assistance of books and journal articles or by the help of trusted friends. Having learned the merits of one kind, let all other sorts alone until such time as their status for culinary use can be positively ascertained.

There are some classes of edible fungi that are very easily identified. They are so unlike any poisonous kinds that the tyro

may be trusted to gather them, guided only by printed descriptions and ordinary illustrations. Thus the honeycomb mushroom, or morel, usually designated *the* mushroom throughout Indiana, on account of its abundance and rather common use by all classes of persons, is very distinctive; and so are the puffballs, large and small, none of which are poisonous. A third class is the inky toadstools, of which three forms are large and abundant. The superior edible qualities of these last are not well known, and it is hoped that the following descriptions and illustrations will enable many persons to make use of this nutritious delicacy who are now unaware of its merits or availability.

While driving one day last autumn, I stopped at the curb to talk with a village friend, and the conversation turned upon mushrooms.

"I so much like mushrooms, as does all the family," said my friend, "but I cannot get away from home to find them, and even if I could, I would not know where to look."

"But," I said, "you do not have to go away from home to find them, for near where you stand, at the base of that maple tree, are enough for one good meal; or at least would have served for a meal yesterday, for they appear rather passe now," and I pointed to a large cluster of the tan-colored coprinus not ten feet away, growing in the parking about the base of a large shade tree.

"Really, I supposed those were toadstools," came the reply in much surprise, "I never should have thought of eating them."

Of course they were toadstools, but a most acceptable variety. The tan-colored coprinus (*Coprinus micaceus*), or sparkling coprinus, as the Latin name indicates, is a very common fungus in this country, as it is also in Europe (Plate I, B). It usually grows in dense clusters at the base of living trees, although it also occurs in small open groups, and sometimes singly, in lawns and on logs in the woods. The individual plant consists of a cylindrical stem two to four inches long when fully grown, bearing a half-expanded cap about an inch in diameter. The stems are of the size of small pipestems, hollow, and of a dirty white or brownish color. The cap is fragile. At first the gills underneath are white but soon begin to blacken, especially at the edges, and finally become quite black. When less than half grown, the upper surface is sometimes covered with glistening flakes, but this is by no means invariable. Otherwise the surface is essentially smooth, and of a tan color, varying to light buff or yellowish brown. Fine radial lines run from near the center to the margin of the cap, which are, however, easily overlooked.

They usually grow in masses a foot or more across; and the individuals, which are of all sizes, are more or less compressed and

distorted, particularly the smaller ones. Plate I, B, gives the habit of the fungus very well. The photograph was taken from a portion of a large mass, and shows how tightly the stems were pressed together at the base. Plate 4 shows a tea-plate of the tan-colored coprinus ready to cook, one-half natural size.

In dry weather the cap shrivels and dries in the midday sun. But when the weather is damp, the upper surface becomes moist and a little mucilaginous, while the whole cap gradually dissolves into an ink, beginning at the edges, and drips away until the clump exhibits an unsightly mass of distorted stems smeared over and connected with strings and masses of black slime.

The time to gather these fungi for the table is before they have become much blackened underneath.. The blackening does not make them unpalatable or harmful, but it greatly detracts from the appetizing appearance of the prepared dish, which assumes an inkiness several degrees deeper than would be predicted from the appearance of the uncooked material. It is a good rule, moreover, regarding all fungi, to discard over ripe and stale specimens, for occasionally they develop poison as they approach decay, and if they do not, may yet cause sickness, as other stale vegetables and meats are apt to do.

The method of preparation for cooking is merely to rinse them to remove dust and bits of dirt. Some persons think it best to peel all mushrooms, but it is a needless and wasteful method, and especially so with the three forms of coprinus here described. If they are carefully gathered and handled, there should be no dirt among the gills, and only the top and stems need washing.

The tan-colored coprinus, like the other species of coprinus, will not keep long after gathering. It is best to serve them the same day they are obtained. Even when placed in an ice box they can rarely be kept twenty-four hours in condition to be eaten, unless they have been gathered when not more than half grown.

The tan-colored coprinus has been described first, not because it is the best or most easily recognized, but because it is the most common, growing in yards and streets as well as in field and forest, and appearing more or less abundantly throughout the warm months.. In May and June, and again in September and October, it is usually common, while during midsummer occasional clumps may be seen.

The gray coprinus or true ink-cap (*Coprinus atramentarius*), flourishes during spring and fall, a warm shower often bringing it out in great numbers, but is rarely seen in midsummer. It is a plump, thick-meated variety, much larger than the tan-colored kind, but like it, grows in crowded clumps (Plate 2). It occurs in rich pasture land, open woods, and especially about city lots and

streets which have been filled with general refuse, street sweepings, and other decomposable material mixed with soil. One may often see it in the parking between sidewalk and street, or in rich lawns.

The caps are egg-shaped, borne on short, thick stems. They do not noticeably expand until deliquescence begins, and then not very widely. The edges of the cap are drawn in and give a somewhat puckered appearance to the lower portion, and where they touch the stem it appears to be crushed in as if by pressure (Plate 2, B). The surface of the cap is a dull ashen gray, varying to silvery gray and sometimes to a grayish brown. It is usually smooth, but occasionlly slightly roughened or scaly, especially toward the top. When moist it has a mucilaginous feel. The ink-cap is so much larger and more compact than the tan-colored coprinus that it takes five to eight of the latter to weigh as much as one of the former, in the same state of development. The two forms pass through the same stages of deliquescence. An over ripe mass of ink-caps is shown in Plate 1.

The shaggy coprinus, or horse-tail mushroom (Plate 3), is by far the largest, most conspicuous, and most distinctive of this class of toadstools. It is common in spring and fall in similar situations to those chosen by the ink-cap. The groups are usually less crowded than of the other two kinds, and small groups and single specimens scattered about in grassland are not rare.

Like the ink-cap, they do not expand much until deliquescence begins. They are oblong, often almost cylindrical, and white or nearly so. At a little distance one might fancy a lot of them scattered over a lawn to be goose eggs standing on end, says a facile writer on mushrooms. The surface of the cap is not smooth, as in the other two kinds, but more or less rough and shaggy with curled up tufts of fibers, that are dark tipped, brownish or blackish. Sometimes the roughness amounts to well defined locks falling in waves about the cap, sometimes it is scarcely more than a wooliness of delicate, tangled fibers flecked with color. Between and beneath the shaded tufts and knots, as well as in the gills and stem, the color is either a snowy white or a delicate tinting of pink. The rosy hues are usually more noticeable in large specimens than in small ones, and disappear as the fungus matures.

The shaggy coprinus often appears year after year in lawns of made ground, and if one is so fortunate as to possess such a prolific lawn, he should not let the choicest of delicacies go a begging, but gather each morning's supply with as much thankfulness as the ancient Israelites were wont to express for their daily portion of manna. He may even find it advantageous to do something to preserve and augment the crop. One absolute need

of wild mushrooms is suitable moisture. If they grow within the range of a hydrant, and water is applied so that they do not become at any time either too wet or too dry, a succession of crops may be expected from the same spot at about fortnightly intervals, so long as atmospheric temperature continues favorable. If the supply of water is kept up during the hot months of summer, to keep the mycelium from dying, the mushrooms will appear from year to year, and so long as the soil is amply rich they are likely to increase in quantity, and possibly in size. The amount of water to apply is about what is needed to keep lawn grass in flourishing condition.

Plate 6 shows part of a day's gathering from a small city front-yard, and the writer can vouch for their gastronomic quality, for they were served at his table shortly after the photograph was made. The central toadstool of the plateful, which was somewhat larger than the others, was photographed separately, and is shown in Plate 3. It measured 9 inches in length, and weighed 6 ounces. The plateful was cooked just as they appear, without peeling or removing the stems, except a little of the base in a few cases, where it had been in contact with the soil.

As all this descriptive account will be of little or no service if the next lot of coprinus toadstools that the reader finds is not cooked and eaten, and as the reader is quite as likely to be a novice in the cooking of the dainty morsels as in their detection in the field, a few words upon the culinary part of the subject probably will not be deemed amiss. In the first place, mushrooms, as a rule, are among the tenderest of vegetables, and the three edible toadstools here described are much the tenderest of the mushrooms. Coprinuses need but a brief time in which to cook, fifteen minutes usually being ample, and the flavor is so delicate that the addition of pungent sauces, lemon juice, or other material that will mask the flavor, is to transform a delicious, epicurean dish into a common-place one.

As these toodstools are very watery, they need no addition of water in cooking. A very simple way of cooking and one that brings out well the natural flavor, is to stew them in their own juices with a little butter added, and a dash of salt and pepper. Serve on buttered toast.

Another method is to stew them as before, using about a tablespoonful of butter to a half pound of mushrooms. Stir a tablespoonful of flour with a little cold milk until smooth, then add a half pint of cream, or else of milk. Push the mushrooms to one side of the stewpan, and add the floured milk, with gentle stirring. When it begins to boil, mix in the mushrooms, but do not stir much, or they fall apart and present a less attractive appearance. Serve on toast.

Escolloped coprinuses form a still more delicious dish, although a little more troublesome to prepare. A white sauce should first be made by putting two tablespoonfuls of butter into a sauce pan. When it melts and bubbles add two tablespoonfuls of flour, and stir rapidly until well mixed. Pour in a pint of milk slowly with constant stirring to keep it smooth. Let it boil and thicken, then remove and add a half teaspoonful of salt and some pepper. When the white sauce is ready place in the bottom of a buttered baking dish a layer of either bread or cracker crumbs, and on this a layer of the toadstools, somewhat cut up. Pour over some white sauce. Then add a layer of crumbs and another layer of toadstools, and pour on the remainder of the white sauce. Sprinkle the top with buttered crumbs, and bake in a moderate oven fifteen to twenty minutes.

These are simple ways of cooking the coprinuses that are likely to prove at first as acceptable as any, and are pretty sure to bring out their distinctively delicate and meaty flavor, especially if the cooking is not prolonged beyond the time necessary to make them tender. If other methods are wanted, and a suitable work on edible mushrooms, or a proper cookbook, is not at hand, it will not be amiss to cook them in any manner in which oysters are prepared.

To further aid in identifying the edible coprinuses both common and distinctive characters may be reviewed. The three species agree in having a stem of nearly uniform diameter, with a thick wall, and a few indefinite fibers running through the hollow center. The cap is lightly attached to the summit of the stem, and is densely lined beneath with broad gills. The cap does not spread much until maturity, and then slowly, the gills having largely dissolved into ink before the upper surface becomes horizontal. The liquefying of the cap is a very characteristic feature, and quite separates these toadstools from any poisonous sorts. The tan-colored coprinus and the ink-cap are essentially smooth on the surface, while the horsetail or shaggy mushroom is strongly floccose. In size they range in the order just named, the tan-colored being the smallest and much the lightest. The comparative size, and outline in cross section, may be seen in Plate 7. The comparative external appearance and also size may be gathered by an examination of Plates 4, 5 and 6, which are photographed and reproduced to a uniform scale of one-half natural size. Plate 1, A, shows a group of ink-caps in an advanced stage of deliquescence, and the cut on the title page shows a horse-tail mushroom in the same condition. The drops of ink produced need only the addition of a little glycerine to secure an even flow in order to make an acceptable writing fluid.

A B

THE INK-CAP and TAN-COLORED MUSHROOM.

A. Part of a clump of ink-caps the day after edible maturity. The caps have expanded and largely deliquesced, falling away in inky drops, and the stalks are greatly elongate.. About three-fourths natural size.

B. Part of a clump of tan-colored coprinus taken at edible maturity. Slightly under natural size.

A B

THE INK-CAP MUSHROOM.

A. Part of a clump of ink-caps taken at edible maturity, although not all of full size. Slightly under natural size.

B. A single ink-cap showing the characteristic form, the puckered appearance of the margin of the cap, and the smooth part of the stem where the cap was at first pressed against it. A small specimen, natural size.

HORSETAIL OR SHAGGY MUSHROOM.

A single horsetail mushroom taken at edible maturity. The shaggy surface is well shown. The margin has already separated from the stem and begun to split and expand. Five-sixths natural size.

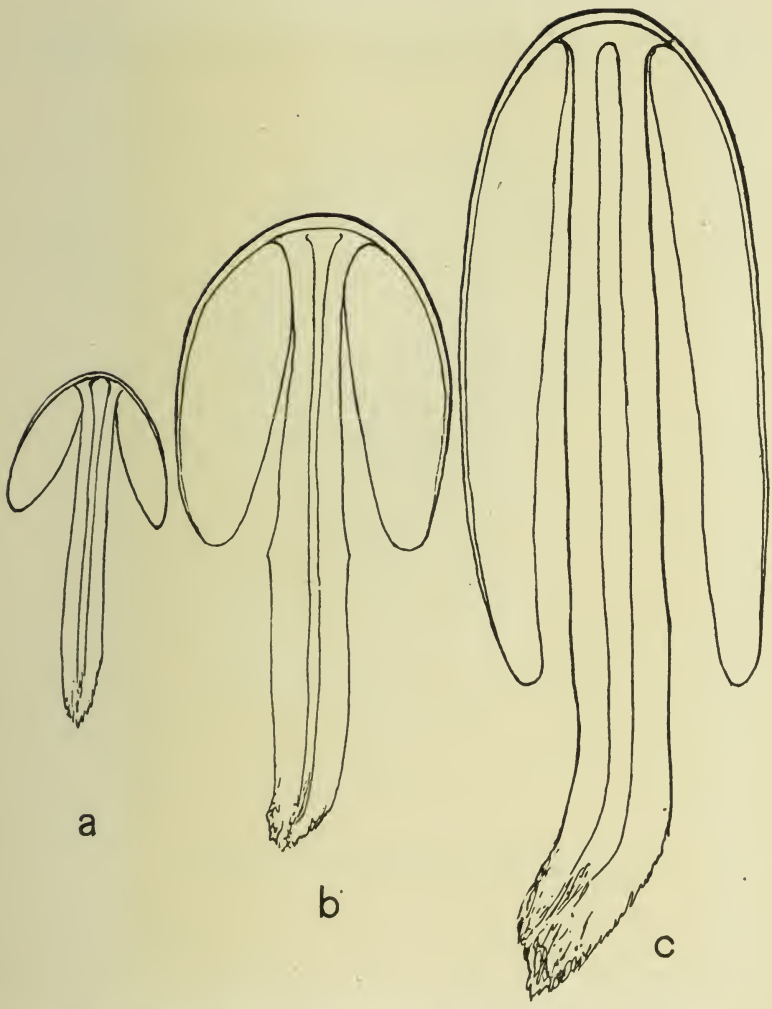
A TEA-PLATE OF TAN-COLORED MUSHROOMS.
(*Coprinus micaceus.*)
These have been held under a stream of running water and the dust removed. They are ready to cook. One-half natural size.

A TEA-PLATE OF INK-CAPS .
(*Coprinus atramentarius.*)
These have been held under a stream of running water and the dust removed. They are ready to cook. One-half natural size.

A TEA-PLATE OF SH AGGY MUSHROOMS.

(*Coprinus comatus.*)

The central specimen is the same individual as shown on Plate III. The variation in different specimens from a very shaggy to a mealy surface is well shown. They are ready to cook. One-half natural size.



Outline of a section through the middle of three edible toadstools: *a* Tan-colored mushroom (*C. micaceus*), *b* Ink-cap (*C. atramentarius*), *c* Horse-tail mushroom (*C. comatus*). Natural size.

Purdue University

Agricultural Experiment Station

BULLETIN NO. 99 VOL. XII.
MARCH, 1904.

Tests of Small Fruits.

Published by the Station:
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Tests of Small Fruits.

By James Troop.

During the past 15 years this department has grown from 100 to 150 varieties of small fruits annually, but the season of 1903 was the most unfavorable for strawberries which we have experienced during that time, owing to late frosts which destroyed fully 50 per cent. of the crop and heavy rains which followed causing a lack of fertilization and an unusual number of knotty or "buttoned" berries. For this reason it would be hardly fair to pass judgment upon their behavior during last season, and were it not that so many questions have been asked concerning them no bulletin would have been issued. But as the greater number of varieties have been grown here for two or more years the results given may be taken as representing a fair estimate of their value on our heavy black, sandy loam, with a gravelly subsoil. In addition to the newer varieties of strawberries, we also have a number of the older varieties such as Bubach, Haverland and Warfield, which have been grown for ten or more years. These are kept as standards with which to compare the newer varieties. The climatic conditions were more favorable for raspberries and blackberries, the latter of which are often injured by a lack of moisture, seldom, if ever, by an excess.

Strawberries.

Our list of strawberries comprises 62 varieties, and a record of the behavior of some of the newer varieties, as to plant growth and bearing qualities, follows:

NOTES ON THE NEWER VARIETIES.

August Luther.—B. This variety originated in Missouri, and has been grown on our grounds for two seasons. It is one of the

earliest varieties, ripening with Beder Wood and Johnson's Early. The fruit is only medium in size, but good quality; plants healthy and vigorous, and fairly productive. Its earliness, however, is its principal recommendation.

Bennett.—P. This is a mid-season variety. Fruit medium in size, bright red, firm, and of fair quality. The plant is a good grower, and moderately productive. It is not a variety that will come into general use.

Bismark.—B. This is said to be a seedling of Bubach. It is about as large as its parent and firmer in texture, a good grower, productive, and being self-fertile, is a good variety for a fancy market.

Bryan.—B. In plant this is about all that could be desired, but for a market berry, it falls short in productiveness, and the fruit is not large enough to make it popular in the best markets.

Bush Cluster.—B. This variety was grown three years ago for the first, and has done fairly well since but it will doubtless follow a great many others which have promised well when first introduced but failed later on.

Dole.—B. A strong grower, but only a medium bearer of fine large fruit. If it was more productive it would do to recommend.

Downing's Bride.—P. This variety has been grown here two years and has given very good satisfaction. The plant is a good grower, not quite as hardy as some, but with ordinary winter protection will keep all right. The fruit is large, conical in form, and a bright red color. It is undoubtedly a valuable addition to our market varieties.

Dunlap.—B. While this can scarcely be called a new variety, it is not as well known as its merits deserve. For a general purpose berry, it has few if any superiors, not only on our soil, but reports from other soils and localities show this to be true. The fruit is not quite so dark colored as Warfield, which is a favorite color for canning, but in other respects it is fully its equal.

Early Beauty.—B. This variety originated in Iowa and is said to be one of the earliest varieties grown. It is among the first to ripen, and is fairly productive, but does not show any superiority over some other varieties in other respects.

Emperor and Empress have been grown here for two seasons and while they have borne some nice fruit they have not shown any superiority over many others with less pretentious names.

Enormous.—P. This is a vigorous plant, holding its fruit well up on strong stems, making it easy to pick. The fruit is large, firm, of good color and quality.

Gibson.—B. Midseason, following Beder Wood and other very early varieties, making it a good variety for a succession. The fruit is large and showy, dark glossy red, firm and of good quality; as large as the Marshall, but more productive; a good variety for the fancy market.

Gladstone.—B. This is about the same season as Gibson and about all of the good qualities ascribed to that variety may be repeated here.

Granville.—B. Plant large, vigorous and healthy, fairly productive, fruit medium to large, conical, dark glossy red, a good canner. Season medium to late. We grew this berry before it was introduced to the general trade and have always found it to give good results.

Howard.—P. This is a Michigan variety, grown here for three years. Season medium; a strong grower, berries large, slight conic, bright red, a little too soft for market. If it was a little more productive it would be a valuable variety for the general grower.

Hunn.—P. A very late variety, but is not reliable here. It is said to be wonderfully productive on some soils. It seems to be one of those varieties that each man must test for himself.

Johnson's Early.—B. A very desirable berry either for market or home use. The plant is healthy and a good grower, bearing a good quantity of medium to large berries of good quality. This is a great improvement over Michel's Early which does not pay for the room it occupies on our soil.

Kansas.—P. Fairly productive; fruit rather small and only fair quality. Not a good market variety with us.

Klondike.—B. While the majority of the blooms on this variety are perfect, yet it should be planted with some other variety which blossoms early as some of the early blooms are pistillate. It

is nearly as late as Gandy, and bears a good crop of fine berries, which are a little light colored for canning.

McKinley.—B. Three years' experience with this variety proves it to be a good grower, free from disease, but only moderately productive. The berries are bright red, large, and inclined to be rough. In some localities it has given very good satisfaction.

Miller.—B. This variety came from Mr. Crawford, of Ohio, two years ago, and has shown up wonderfully well. It makes a large, healthy plant which makes a good supply of runners, and bears heavy crops of large, roundish-conical, bright red berries. Its season is from medium to late.

Morgan's Favorite.—B. This variety would give good satisfaction as a home berry, but the fruit, while large, is too soft for shipping any considerable distance.

Nettie.—P. Plant a good grower. Fruit large, light red color, and very tart. Too much so for many tastes.

New York.—B. This variety has fruited two seasons, and seems to be a good variety for either market or home use. The fruit is large, roundish-conical, dark red color, fairly firm and of good quality. Plants fairly productive.

Parsons Beauty.—B. This variety seems to possess about all of the good qualities that go to make up a good market berry. It, however, is most too tart to suit the general taste, but is excellent for canning.

Purdue.—P. Although we have grown this variety for a number of years, it has never been put upon the market. It originated on the Experiment Station grounds, and is the result of a cross between Jessie and Bubach. The fruit resembles Jessie while the plant is much like Bubach; strong and healthy, and more prolific than either. Growing along side of Clyde it has out-yielded that variety, and that means a good deal. We shall not dispose of any plants this year.

Robbie.—B. This variety starts out in a very promising manner, but does not hold up. The season is late, and berries too light for a market variety.

Rough Rider.—B. This variety has been grown here three

years and will be discarded, mainly because of its rough, angular fruit, which renders it unfit to be placed alongside of such varieties as Clyde or Dunlap.

Sampson.—B. This variety and the Miller came from the same lot of seedlings, originating on the ground of Mr. P. J. Miller, of Ohio. It seems to be a worthy companion of the Miller as it possesses most of the latter's good qualities, and is partially pistillate, especially early in the season.

South Bend.—B. This variety originated near South Bend, Ind., and has been grown here several seasons, with good results. It is a fine large berry, and a strong, healthy, vigorous growing plant.

Stahelin.—P. This variety was sent us for trial before it was put upon the market, and it has given very satisfactory results each year. It is one of the earliest to bloom and is recommended for general plantnig for an early variety.

Uncle Jim.—B. A large, healthy and productive plant, with deep, penetrating roots which render it capable of withstanding dry weather, and ripening its fruit to the end of the season, which is quite late. The fruit is large, long-conical, dark red, firm and of good quality.

A Few Older Varieties Recommended for the General Planter.

Beder Wood.—B. For an early pollenizer and for early fruit.

Brunette.—B. If there are some in the family whose digestive system is not quite up to the standard, this is the berry for them to eat.

Bubach.—P. Those who have never planted this old variety should do so this spring. It is one of the largest and most showy berries grown, where well cared for.

Clyde.—B. If one has but a small piece of ground that can be devoted to strawberries, this is the variety to plant. It is wonderfully productive under good cultivation.

Enhance.—B. *and Eureka.*— P. These make a fine pair, when planted in adjoining rows, the one being staminate and the other

pistillate. Both make good, strong plants, and produce good crops of fine berries.

Gandy.—B. For a late berry this is one of the best; coming in just after the earlier varieties are gone, it prolongs the season, producing large, fine berries until red raspberries are ripe.

Greenville.—P. As a mid-season berry this will give excellent satisfaction when planted with some good variety for a pollenizer.

Haverland.—P. An entirely different type of berry from Bubach, and ripens several days earlier. It is one of those varieties that the grower can not well afford to be without. It should be planted with Beder Wood or some other early variety.

Sample.—P. This is another mid-season variety which under good care, makes a very vigorous growth of plants, and produces large crops of large fruit of good quality, and firm enough to ship.

Warfield.—P. All who wish to can strawberries should raise this variety. Medium size, dark, glossy red color, rather acid, it holds its color and flavor better, when canned than any other berry.

Raspberries.

In their present location the varieties have been grown only two years; but many of them are well known varieties, and scarcely need any comment. Our experience for the past eight years in subsoiling ground for raspberries and blackberries has been so successful in preventing drouth that I am convinced that it will pay well to subsoil fifteen inches deep, where the subsoil is very hard and compact.

Table of Varieties of Raspberries.
With the Standing of Each.

Variety and Class	First ripe	Last picking	Vigor of Plant	Hardiness	Productiveness	Size	Form	Quality
Rubus Neglectus								
Caroline	6—15	7—25	8	10	7	m	r	8
Cardinal	6—20	7—15	10	10	9	l	r	10
Columbian	6—20	7—15	10	10	10	l	rc	10
Haymaker	6—20	7—18	10	10	10	l	rc	10
Shaffer	6—22	7—15	9	9	9	l	rc	9
Rubus Strigosus								
Brandywine	6—10	7— 4	10	10	8	m	rc	9
Cuthbert	6—18	7—12	10	10	10	l	rc	9
Golden Queen	6—15	7— 8	10	10	10	l	rc	9
King	6— 8	7— 5	10	10	10	m	r	10
Loudon	6—15	7— 5	10	10	9	m	r	9
Marlboro	6—20	7— 8	7	9	7	l	r	8
Miller	6—10	7— 5	10	10	9	m	r	9
Thompson's Early	6—10	7— 3	9	10	9	m	r	9
Turner	6—12	7— 2	9	10	8	s	r	8
Rubus Occidentalis								
Black Diamond	6—18	7—10	10	10	10	l	r	10
Conrath	6—10	7— 2	10	10	10	l	r	10
Cumberland	6—15	7—10	10	10	10	l	r	10
Eureka	6—14	7— 5	10	10	10	m	r	10
Gregg	6—20	7—10	9	8	8	l	r	9
Hilborn	6—14	7—10	10	10	9	m	r	8
Kansas	6—15	7— 5	10	10	10	l	r	10
Lovett	6—16	7— 2	9	10	8	m	r	9
Munger	6—12	7— 8	10	10	10	l	r	10
Nemaha	6—21	7—12	10	10	10	l	r	9
Older	6—15	7—10	10	10	9	m	r	9
Palmer	6—12	7— 1	10	10	8	m to s	r	8
Souhegan	6—10	7— 2	9	10	8	l	rc	9

Blackberries.

We can never be certain of a blackberry crop on the Station grounds, as a drouth during the ripening season is sure to cut them short. The past year however, was an exception and all varieties did their best. The following varieties have fruited but two years in their present location.

Following is the record in tabular form:

VARIETY	First ripe	Last picking	Vigor of Plant	Hardiness	Productiveness	Size	Quality
Rubus Villosus							
Agawam	7— 2	7—25	9	10	8	l	9
Briton	7— 5	7—24	9	10	9	m	8
Early Harvest	6—30	7—12	7	6	6	s	9
Early King	6—30	7—12	8	8	7	l	9
Eldorado	7— 5	7—22	10	10	8	m	10
Erie	7— 5	7—20	10	9	9	l	10
Kittatinny	7— 3	7—18	10	10	8	l	9
Ohmer	7— 5	7—20	9	10	8	l	9
Rathburn	7— 2	7—20	10	10	10	l	10
Stone	7— 7	7—20	9	9	7	m	8
Taylor	7— 2	7—18	9	10	8	m	10
Wachusett	7— 8	7—22	9	10	8	l	9
Western Triumph	7— 8	7—22	10	10	9	m	9
Snyder	7— 5	7—25	10	10	9	m	9

Purdue University

Agricultural Experiment Station

BULLETIN No. 100. Vol. XII
SEPTEMBER, 1904

DISEASES OF SWINE

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Diseases of Swine.

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GENERAL STATEMENT.

This brief monograph upon the diseases of swine is presented with the view of giving some help to the numerous breeders of swine. It is not offered as a complete treatise—just as a little helper. The swine breeder can not purchase books upon the diseases of his animals as may be done upon the diseases of horses or cattle, as there are few works that treat upon the subject. It has been only a short time since it was thought to be easier and cheaper to raise a new lot of pigs, than to give much attention to treating their diseases. This condition is rapidly changing. Individual hogs now bring the price of a good horse so often, that the same attention is demanded in caring for them. The number of hogs that bring more than one hundred dollars each, has rapidly increased in the past few years and an occasional animal brings more than a thousand dollars. The annual production of swine amounts to more than $20,000,000 in this State. There are more persons engaged in raising pigs than in any other part of the live stock industry except poultry. The annual losses reach about $2,000,000, so there is demand for information that will help to reduce this loss both by prevention and treatment. This is further shown by the fact that there are more inquiries concerning the diseases of swine than are made concerning the diseases of cattle and horses.

Acknowledgement is due to the Office of State Veterinarian for a large part of the work herewith presented.

DISEASES IN GENERAL.

As a matter of convenience and to aid in understanding diseases, we divide them into three classes, sporadic, contagious, and infectious. This classification is purely arbitrary and is based upon the nature of the cause. Sporadic diseases are those which have no one constant cause. A variety of causes may produce the same disease. Colic, diarrhoea, rheumatism, colds, etc., are types of sporadic diseases. Colic for example may be caused by a change of food, by green food, by spoiled food, by watering when the animal is too warm, by contaminated water, by drugs, by exhaustion, by exposure, by intestinal worms, etc. There is no single cause for colic, colds or any other sporadic disease. In sporadic diseases, the disease can not be conveyed from one animal to another as there is no specific germ or other organism acting. If several animals are affected alike at the same time, it is because all have been subjected to like causes and not because it has spread from one to another. As a rule, only one or a few animals of a stable, herd or flock are affected at one time and there is no tendency to spread.

Contagious diseases are those which are always produced by the same cause, and the causative factor may be communicated from one animal to another of the same species, or in some cases to animals of different species. When we speak of strictly contagious diseases, we usually have reference to those due to germs, or animal life that are normally parasitic and do not live or multiply outside the body, and which require comparatively close contact in order to spread. Distance, or a comparatively short time between the coming of animals to the same place are sufficient to prevent the spread. In other words, the germ does not pass an indefinite distance between the animals or live for a long time outside the animal's body. As examples of this type of disease, we have sheep scab, tape worms, glanders, pleuro pneumonia, etc. In the case of sheep scab the cause is always the scab mite; it can not travel alone and will not live in the pens, in the cars, on the fences or other objects with which the diseased sheep may come in contact for a long time. Therefore sheep separated by a roadway, or flocks using the pens where diseased sheep have been some months prior do not become affected. Pleuro pneumonia in cattle is also a contagious disease and at one time had a foothold in this country. It is a disease in which the germ does not live long

outside the body and is only carried by contact or artificial means. It was eradicated by destroying all that were affected and disinfecting the places where it had been. Glanders among horses is also contagious and it is only spread by contact or close association. All strictly contagious diseases are controllable and could be exterminated by united effort. The drastic measures used to stamp out pleuro pneumonia would stamp out sheep scab in a short time.

Infectious diseases are those caused by some special agent or parasite and the cause may live and multiply outside the body. Infectious diseases may be and frequently are contagious. Some infectious diseases however are not contagious. The line separating contagious and infectious diseases is not very clear. The distinction is largely one of degree. Among the types of infectious diseases we have lumpy jaw, and blackleg of cattle; distemper, and influenza of horses, cholera, and swine plague in hogs, and roup in poultry. True lumpy jaw of cattle is always caused by ray fungus. The fungus is obtained upon the food which the animal takes, the disease is rarely spread by the discharges from the wound. Blackleg is obtained from the pasture or forage, the germs being known to live for a long time outside of the body. Influenza and strangles occur in epidemics because the germs live outside of the body and under favorable climatic conditions develop generally, thus causing widespread outbreaks at the same time. Hog cholera and swine plague are both infectious and contagious, the germs live outside the body and no amount of separation of herds will ever stamp out the diseases. It only decreases the number of cases. The germs of tetanus or lock jaw are to be found growing in the soil, but do not cause trouble unless accidentally introduced into a closed wound. Infectious diseases can not be wholly controlled because the occurrence in an animal is not essential to the life of the germ. Some may be prevented by vaccination, as blackleg, and some have been greatly reduced by learning the habitat of the germs outside of the body and making those places uncongenial for their growth.

THE CAUSES OF DISEASE.

The causes of disease are the indirect or predisposing causes and the direct or exciting causes. The predisposing causes are any factors which

tend to render the body more susceptible or to favor the presence of the exciting cause. The exciting cause is the specific agent or thing that induces the diseases. To illustrate, an animal having a narrow, pinched chest may be in health but when subjected to the same conditions as its companions, it contracts disease while they do not. The lessened lung capacity has rendered the animal susceptible. Hogs pastured on high dry ground and fed on clean feeding floors are generally free from intestinal worms, while hogs pastured upon low wet ground and fed in the mud are frequently infested with worms. In the first case the predisposing cause was in the animal, in the second, it was in the surroundings. Among the causes of disease we may briefly consider the following:

Age.—Young animals are more subject to attacks of contagious or infectious diseases than old. White scours, suppurative joint disease, and infectious sore mouths are diseases of the first few days or weeks. Thumps occur early. Cholera occurs with much greater virulence in those under six months of age than in the older. Lung worms or whooping cough occurs between two and four months. Swine plague attacks the older hogs. Trichinae likewise more often occurs in mature animals. As a rule, the young are more subject to acute diseases and the old to chronic troubles.

Sex.—The matter of sex has little bearing on the diseases of swine other than those due to farrowing.

Breed.—The matter of breed is of less importance in the diseases of swine than in other domestic animals. Some breeds are more active than others and thereby seem to have increased resistive powers to some troubles. For example, pigs from the more active breeds seldom have thumps if allowed exercise. It is the lazy, fat fellows that are particularly susceptible.

Care and Feeding.—These are factors of great importance. The feeding of unsuitable foods, as city swill, dirty, sour slop, those containing large quantities of soaps, feeding too heavily when too young, feeding full rations of green corn as soon as it is ready, feeding cotton seed, feeding with too limited exercise, pasturing upon clover sod where there are many grub worms and upon land known to be infected with parasites, are all factors contributing to some forms of disease.

Shelter.—Sudden changes of temperature, extremes of heat and cold,

exposure to storms, etc., all have their effect. Piling under straw stacks and hot sheds prediosposes to pneumonia. Lying in damp beds causes skin troubles. The hog does not need a great deal of shelter, but needs that dry and comfortable.

Location.—Sometimes the difference of a few rods makes the difference between having disease in a herd and not having it. A dry, protected site is always preferable to one in the open or low.

Water supply.—The work of this Station has been such as to prove that only well water, deep well water from a tubular well, can be recommended for all kinds of farm animals. This applies with possibly greater force to the hog than to any other class because cholera, a water borne disease, is the principal scourge. In actual practice, however, the reverse condition prevails.

Previous disease.—The effect of one attack of an infectious disease as a rule confers immunity against a subsequent attack. This is not true of all, but of many. One attack of cholera will not give complete immunity, but does reduce the chances of a second attack. The effect of one disease may weaken a part and make the animal susceptible to some other trouble, as lung worms may make it easy to acquire pneumonia.

Vital causes.—The vital causes are all living organisms, either plant or animal, that act as parasites at any stage of their existance. They may be either accessory or direct causes. The animal parasites are lice, intestinal worms, flukes, trichina, etc. The plant parasites are nearly all bacteria; the cause of cholera, swine plague, scours, joint disease, sore mouth, etc. They may act as accessory causes, as the lung worm may prepare the way for pneumonia, or directly cause it, as in the case of the cholera germ.

DIAGNOSIS AND SYMPTOMS.

In examining a hog the behavior, appearance, general conditions and surroundings must all be taken into consideration.

The grouping of symptoms into signs of disease is not as difficult in the hog as it is in some of the other farm animals, but in order to recognize any deviation from the normal, we must be familiar with the habits of the animal, the structure and the physiological functions of the

body, or at least possess a practical knowledge of these things. Swine breeders have plenty of opportunity to learn this from personal observation; without this knowledge it is not possible to care for, or treat hogs in an intelligent manner when sick.

The general symptoms, those affecting the entire system, inform us as to the condition of the animal at the outset and during the progress of a disease. Thus we have the symptoms connected with (a) the pulse; (b) the respiration; (c) the body temperature; (d) the mucous membranes; (e) the surface of the body; (f) the secretions and excretions; and (g) the nervous system.

All of the general symptoms manifested by the hog are seldom considered either in the diagnosis or the treatment of disease. There is no reason, however, when treating valuable stock hogs, why a full knowledge of the condition of the animal should not be of the same importance as in the treatment of other domestic animals, and if possible this should be obtained.

Pulse—The pulse can be easily taken in the hog from the femoral artery on the inner side of the thigh. The artery crosses this region in an oblique direction and is quite superficial toward the anterior (forward) and lower part. The normal number of pulse beats per minute is usually estimated at about seventy to eighty. In young pigs, and when the animal is exercised or excited, the rate is much higher.

The following varieties of pulse are recognized in disease: frequent or infrequent, quick or slow, large or small, hard or soft and regular or intermittent. The frequency of the pulse has reference to the number of pulsations per minute; quick or slow to the time required for the pulse wave to pass under the finger; large or small, to the volume of blood that passes at each beat; hard or soft to the sense of feeling while the blood is passing under the fingers; and regular or intermittent to the intervals between the beats. There may be a number of beats regular and in time and then the missing of one or two, or there may be increased rapidity of a few beats and then a decrease. The condition of the circulation may also be judged by placing the hand on the left side of the chest and as nearly over the heart as possible.

Respirations.—The number of respirations per minute is subject to considerable variation. When at rest, they will vary from ten to twenty;

if warm or excited and during exercise, from sixty to about one hundred. In hogs, normal respirations are frequently accompanied by respiratory sounds. In disease the respirations may be quickened and their character changed, as in pleurisy, peritonitis, pneumonia, etc. In the abdominal form of respiration, the movements of the walls of the chest are limited. This occurs in pleurisy. In the thorasic form of respiration the abdominal wall is held rigid and the movement of the walls of the chest make up for the deficiency. This latter condition is seen in peritonitis.

In inflammation of the air passages and irritation from dust or parasites, the secretions from the lining membranes are modified and there is usually sneezing or coughing. In the different diseases of the respiratory organs, the modified sounds are of much value in the diagnosis and in indicating the progress.

Temperature.—The body temperature is taken per rectum, the ordinary fever thermometer being used. The normal temperature of a hog will vary from 100.5 to 105 degrees Fahrenheit, the average being about 103. In order to determine the normal, it is well to take that of some of the other animals in the pen and make a comparison. Exercise and warm pens will increase body temperature, cold weather and drinking cold water will lower it.

Mucuous Membrane.—In health the visible mucous membranes are usually a pale reddish color, and when inflamed, they are a bright red. In collapse, internal hemorrhage, impoverished or bloodless conditions of the body the membranes are pale.In indigestion, that lining the mouth may appear coated; if irritated, excessively moist; and if the hog is feverish, dry. In serious diseases, especially febrile disturbances, secretions may accumulate around the margins of the eyelids and the eyes appear dull.

Skin.—Healthy hogs should have a smooth, rather heavy, glossy coat and the skin feel mellow and soft. When the skin loses its elasticity, becomes hard, rigid and scurvy and the hair rough and harsh, it indicates a lack of nutrition and an unhealthy condition of the body. When the coat is thin or the hog affected with external parasites, irritation from the sun and parasites may cause it to become greatly changed.

Excretions.—The character of the excretions from the kidneys and bowels become modified in some diseases, and should be considered in making a diganosis.

Nervous System.—The state of the nervous system is indicated by dullness, excitably, or delirium. The hog may stagger, walk stiffly, drop the head, turn the head to one side, walk in a circle, have convulsions or show paralysis of a part of the whole body, as a result of nerve involoment. These symptoms may occur as an involvment in several diseases, or arise from primary affections of the nervous system.

ADMINISTRATION OF MEDICINE.

The diffrent methods of giving medicine are as follows: (a) by way of the mouth, in the feed or as a drench; (b) by injection into the tissues beneath the skin; (c) by rubbing into the skin; (d) by the air passages and lungs; (e) by the rectum.

By way of the mouth.—Hogs possess a rather simple digestive tract, and are very susceptible to the action of drugs when given in the feed or as a drench.

If the hog is not too sick to eat and the drug does not possess an unpleasant taste, it can be given in the feed. If soluble, milk can be used; if insoluble, ground feed is to be preferred. In all cases the medicine must be well mixed with the feed. When a large number are to be dosed it is best to separate them into lots of ten and feed each lot separately. When this is done, there is greater certainty of each getting the proper dose and the danger from overdosing is avoided. In the case of young pigs, we can take advantage of the fact that some drugs are excreted in the milk, and administer the drug to the mother.

Drenching a hog is not difficult if quietly and easily managed. A large herd can be drenched quite rapidly if driven into a small pen, as the hogs will be in such close quarters that they can not get away. To secure the hog while drenching it, a noose of sash cord or a small rope can be placed around the upper jaw well back toward the angles of the lips, and the medicine administered with a metallic dose syringe. Sometimes when the drench is bulky, and the hog hard to hold, it is necessary to elevate the head and raise the fore feet off the ground. For this purpose a pulley and a rope wire stretcher is recommended. It should be hung in some convenient place in the pen and the animal secured in the usual way by placing a noose over the upper jaw. The rope is then thrown

over the hook in the lower pulley and the hog drawn up until it is almost off its feet. The drench must not be administered until the hog is quiet and well under control, as there is some danger of the medicine getting into the air passages and doing harm. If there is danger of the hogs getting mixed in the operation, as soon as one is drenched it can be marked with paint.

Drugs, when soluble, are best given in water or milk; when insoluble, in syrup or oil. Instead of a syringe a long necked bottle, or a funnel with rubber tubing and an iron nozzle can be used.

By injecting into the tissues beneath the skin.—This method of administration is suitable when the drug is non-irritating, the dose small and when prompt, energetic effects are required. The needle and hypodermic syringe should be sterile, and the place of injection washed with an antiseptic wash in order to prevent the formation of an abscess. The point of injection should be where the skin is thin, as the flank, belly, ear, or inside of thigh. The needle is introduced through the skin and the medicine injected beneath it by slowly pushing the piston. In the case of fat hogs the injection should go into the muscular tissue; otherwise it will not be absorbed promptly.

By the way of the air passages and lungs.—This method of administration is practiced but little, and usually for a local effect on the respiratory organs only. The hog or hogs, are put into a tight enclosure and allowed to inhale vapors of the drug. Drugs suitable for this purpose are turpentine, creolin, eucalyptol, sulphur, etc. Turpentine is the one most used and is easily disseminated by pouring on hot water or by putting an ounce or two on hot bricks. Care must be exercised when treating hogs in this way, as they may suffer from lack of air.

By the way of the rectum.—Enemas or clysters are usually given for a local effect on the rectum or to accelerate the action of a purgative. To administer an enema a fountain syringe is best. The nozzle of the syringe should be smeared with vaseline before introducing it into the rectum. When the injection is large, it is well to elevate the hind parts of the hog. A gallon or more can be introduced into the intestines in this way. A funnel and rubber tubing, or an ordinary syringe can be used for this purpose.

PREVENTIVE TREATMENT.

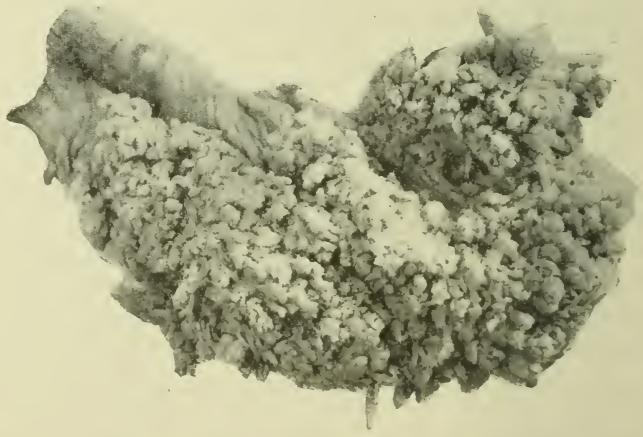
Preventive treatment is recognized by all successful hog raisers as the most successful and economical method of combating disease, and it is along this line that the greatest attention should be directed. Disease is best combated by correcting the faults in breeding and feeding, by good hygienic surroundings, by ample exercise, fresh air and sunlight, clean yards and pens, and the free use of disinfectants.

DISEASES OF THE DIGESTIVE SYSTEM.

STOMATITIS.

Sore Mouth.

Causes.—Putrid or decomposing slops, irritating or hot foods, drenches, the water in foul wallows, especially that containing much seepage from the manure pile, are among the common causes of simple stomatitis in swine. Decayed teeth, irritation from awns or beards of grasses, as barley and wheat, in the feed, and rope loops used in catching hogs may also cause it. Circumscribed inflamed patches on the mucous membrane of the mouth are sometimes seen in hog cholera, swine plague, anthrax, actinomycosis, and other diseases.



Papilloma of the tongue. A warty growth seen on the tongue in rare cases.

Symptoms.—The mucous membrane of the mouth is hot, dry and red in appearance. Ropy saliva dribbles from the corners. The animal champs the jaws and seems to find relief in running its nose into cold water. There is a disagreeable odor from the mouth. Mastication is painful and the hog shows a disposition to eat sparingly. Soft liquid food is preferred; hard food is imperfectly masticated and may drop from the mouth. Recovery usually takes place in a few days.

Treatment.—If due to irritating foods, the cause must be removed. Hard food should be withheld and nothing but sloppy foods be fed to the animal when in this condition. Plenty of cool, clean water should be placed where the hog can drink and run its nose into it. The medicinal treatment consists in washing the mouth twice a day with an astringent wash or antiseptic lotion. A four per cent. watery solution of boric acid or alum can be used for this purpose. The coal tar washes are also serviceable.

DISEASED TEETH.

The hog eats all sorts of objects and cracks nuts, coal, gravel, etc., upon the teeth, so that when the hog becomes old he is almost sure to have a bad mouth. Hogs sold for stock purpose are seldom affected in this way. Boars sometimes have very long tusks.

Symptoms.—The symptoms of some derangement of the teeth are pain upon grinding, holding the head to one side while eating, insufficient mastication, as seen in the half or whole grain passed, and inability to shell corn from the ear.

Treatment.—The treatment is to give largely ground or sloppy food, and pasture. Cut off with dentist's cutters all long tusks, but do not knock them out with a punch or cold chisel, as the latter method is almost certain to crack the teeth and fracture the jaw.

BLACK TEETH.

This condition is frequently brought to the attention of the veterinarian, but as yet we have no satisfactory explanation to offer for their presence. They are also found in health, as may be observed in heads at the slaughter house. Undoubtedly too much stress has been laid upon this condition. We are not inclined to attribute any disease to this condition upon the present evidence. In very young pigs, when this condition

is most frequently seen, there may be very long, sharp teeth present which it would be better to cut off. At the time of dentition, the temporary tooth may be present as a dark shell and the gums be made sore and cause the pig to hold the mouth open, to salivate, and to refuse food.

DEPRAVED APPETITE.

Causes.—Depraved appetite is due to a variety of causes and may occur as a symptom in different diseases. Faulty rations, especially if deficient in alkaline and earthy salts, lack of exercise, digestive disorders and a nervous condition may cause it.

Symptoms.—The hog shows an inclination to eat all sorts of indigestible substances, earth, sand, feces, bristles, rotten wood, etc. Sometimes they are quarrelsome and may attack one of their numebr and kill it. Sows will eat their young, usually at the time of birth. When thus affected they do not thrive as they should and may become quite thin.

Treatment.—The treatment is chiefly preventive, and consists in supplying to the ration whatever elements are wanting. The addition of charcoal, salt, wood ashes, etc., sometimes answer the purpose well when the other ingredients seem to be about right. When the affection is due to chronic indigestion, they should be given the proper treatment.

GASTRITIS.

Acute Indigestion.

Causes.—Overloading the stomach and spoiled foods, especially putrid swill, are common causes of indigestion. Alkaline washing powders and soaps, irritate the stomach and intestines and may bring about this condition. Poor care, exposure and intestinal worms may also cause it.

Symptoms.—The hog refuses food, is generally restless and may have colicy pains. It usually wanders off by itself, acts dull, grunts, lies down in a quiet place or stands with the back arched and abdomen held tense. It seems to like to hide itself in the bedding, litter around the manure heap or straw stack, and in the grass or weeds. When vomiting occurs early in the attack, recovery usually takes place in a short time. Sometimes the animal has a diarrhea. The body temperature may be higher than normal.

Treatment.—Feeds that will irritate the stomach or intestines should be avoided. It is desirable to induce vomiting as soon as possible by giving an emetic of ipecacuan, (twenty or thirty grains in a little warm water). This can be followed by two or three ounces of castor oil. The hog should be kept in the pen and fed on easily digested ration.

CHRONIC INDIGESTION.

Causes.—When the causes of acute indigestion act for some time either in an intermittent or continuous manner, it will terminate in the chronic form.

Symptoms.—In the beginning these may be the same as in the acute form. The hog presents an unthrifty appearance and may become quite thin. Pigs grow slowly and may become badly stunted. We may observe constipation and diarrhea alternating.

Treatment.—Clean quarters and a well balanced, easily digested ration should be provided. The hog should have access to plenty of common salt and charcoal. As a tonic the following mixture can be given in the feed; bicarbonate of soda (two ounces), powdered gentian (three drams), sulphate of soda, (three ounces). The dose is about one teaspoonful twice daily. To check the diarrhea, give nitrate of bismuth in dram or half dram doses. If constipated, a cathartic of calomel (ten to twenty grains) will give relief.

GASTRO-ENTERITIS.

Inflammation of the Stomach and Intestines.

Inflammation of the stomach cannot be readily distinguished from that of the intestines and vice versa. Frequently both are inflamed at the same time. It is therefore more convenient to discuss both under the head of gastro-enteritis.

Causes.—This disease is largely due to unhygenic conditions. Some people seem to think that a hog can eat anything and take poison with impunity, and as a result, it frequently suffers from ignorant practice in the feeding, care, and giving of drugs. The causes of gastro-enteritis are much the same as in indigestion, only they act more intensely. We must

especially mention dirty, filthy yards and pens, decomposed and over kept foods. When hogs are kept in filthy quarters, the snout and food become soiled with all sorts of microbes. These enter the digestive tract along with the food, irritate the lining membrane and pave the way for those germs that would otherwise prove harmless. Toxic or poisonous substances, as salt brine, washing powders, dish water, etc., that are frequently found in the swill, may cause it.

Symptoms.—The animal shows evidence of severe abdominal pain. The back is arched, ears droop and the abdomen is tucked up. When the abdomen is pressed on, it will cause the hog to flinch with pain. Pain is manifested by grunting, squealing, restlessness, champing and grinding of the teeth. The body temperature is elevated. If the offending matter is fermentive or obstructive, there is bloating. When the stomach is involved, vomiting is a prominent symptom. The inflammation at first causes an intense thirst, and the bowels are constipated. Later a diarrhea is present. The hog becomes very dull and weak, and is generally seen lying down in a bed that it has rooted for itself in the litter.

There is no rule as to the duration of the disease. It may last but a short time or continue for a week or more.

Lesions.—The post mortem appearance is a congested and inflamed condition of the mucous membrane lining the intestines, sometimes involving the deeper layers of the wall and the peritoneum; the contents are mucous and flakey in character. The lymphatic glands are reddened and thickened, and if the inflammatory changes are due to a slow infection there may be small pouch like (follicular) ulcers in the mucous membrane.

Treatment.—The hog should be kept in clean quarters. If vomiting has not occurred, the offensive material should be gotten rid of by giving an emetic of ipecacuan (twenty or thirty grains in a little warm water). This can be followed by a laxative of castor oil, one or two ounces, or calomel in from ten to thirty grain doses can be given. To relieve the pain a teaspoonful of laudanum in about the same amount of linseed oil can be given. Rectal injections of soapsuds may be necessary to relieve the constipation. If diarrhea is a symptom of the disease, nitrate of bismuth in dram or half dram doses can be given two or three times a day. As a counter-irritant, oil of turpentine may be applied to the walls of

the abdomen and covered up until the skin is quite red. The best diet is well boiled, thin gruels. This should be fed until the hog is able to digest the ordinary ration.

TOXIC GASTRO-ENTERITIS.

POISONING.

Meat brine and washing powders are the most common causes of poisoning in swine, and are always accompanied by an inflammation of the intestines and stomach.

POISONING BY MEAT BRINE.

Brine from meat barrels and fish kegs is sometimes emptied where hogs have access to it and when eaten will cause an intense inflammation of the stomach and intestines. Hogs will not eat too much salt if they have access to it at all times, but the meaty taste of meat brine probably adds to their desire for it, and is eaten in large quantities.

Symptoms.—These develop in a short time. The animal is restless at first, will run from one place to another, lie down and get up again, stamp the feet and squeal. Vomiting nearly always occurs and a profuse watery diarrhea will come on if the hog lives long enough. Convulsions occur, during which it will throw itself around violently and froth at the mouth. The intervals between the convulsions become shorter and shorter as death approaches. The posterior parts are paralyzed and the animal will drag itself from place to place. The duration of the attack varies from a couple of hours to several days. The animal is sometimes suspected of being mad unless the cause be known.

Lesions.—Upon post mortem the lining membrane of the stomach and intestines is found loosened, sometimes in masses, and there is intense congestion of the entire wall and the peritoneum in contact with it.

Treatment.—The hog should be given all the water it will drink. Linseed oil in large doses can be given. Flaxseed tea is also useful. To quiet the pain, at intervals, a teaspoonful of laudanum can be given. Treatment is seldom successful.

POISONING FROM WASHING POWDERS.

It is a common practice to save the dish water as slop for pigs. Hogs fed on such slops often sicken and die, the symptoms and course of the

disease being very much like cholera and are frequently confused with this disease.

Symptoms.—These are diarrhea, vomiting, fever, lameness, partial paralysis, nervous disturbance and death. The course of the disease is from a few hours to several days, apparently depending on the amount of alkali ingested at one time. Death occurs in the majority of cases.

Lesions.—Upon post mortem examination, the lymphatic glands along the bowel are found swollen and dark colored. The mucous membrane lining the intestines is pale and shiny. Other internal organs are also involved.

Treatment.—The treatment is wholly preventive and consists in avoiding the feeding of slops containing these alkalies.

POISONING BY FEEDING COTTON SEED.

Fatal results follow the feeding of cotton seed, whether given ground, roasted, raw, boiled or as droppings from cattle. Poisoning, however, is not always observed in hogs following cattle fed on this food stuff. The cause of the trouble has not been discovered, all attempts at getting an active extract from the seed having proven unsuccessful.

Symptoms.—The evil effects are not noticed until several weeks after using it as a food. In cases that have been observed throughout the whole course, there is first, dullness, staggering gait, labored breathing, spasmotic in character and usually called thumps, loss of sight, restlessness, walking in a circle and running into obstructions, lying down flat on the belly, and finally sudden exhaustion and death. In the majority of cases, the animals are found dead in their beds or pens ten or twelve hours after they had apparently been in the best of health.

Lesions.—A post mortem examination gives no definite lesions and fails to show any effect that might be attributed to the hulls.

Treatment.—The only treatment that can be recommended is preventive, avoid using cotton seed in any form as food for hogs for more than two weeks at a time.

ERGOT POISONING.

Causes.—Hogs may be poisoned by eating the screenings from the thresher or elevator that contains considerable quantities of this fungus.

It may possibly be produced on psture, particularly rye pasture. This fungus occurs principally on the heads of rye. The disease is not common and when reported in this State, it has almost always been associated with the feeding of screenings and boughten mill feed containing large amounts of the screenings.

Symptoms.—These are lameness like rheumatism, local swelling and tenderness, especially about the joints of the feet although not confined to that region. Gangrenous spots occur upon various parts of the body. The extremities, especially the ears and tail, loose their natural warmth and vitality. Deep red spots that become black and gangrenous appear on the skin. The mouth may become sore. Parts of the ears and tail will crack and drop off and pieces may come out where gangrene occurs on other parts of the body. There is swelling of the eyes, loss of appetite and unsteadiness in standing or walking. In extreme cases the hog may loose one or more feet before dying. The disease may be confused with blood poisoning. The occurrence in several individuals at the same time will aid in making an early diagnosis.

Treatment.—Cut off the poisonous feed. Supply a soft, easily digestible diet. Give iodide of potash in ten to fifteen grain doses twice daily in slop.

EFFECT OF EATING WHEAT AND BARLEY BEARDS.

Frequently when hogs are turned on wheat or barley stubble some will die. The symptoms which they present will vary. In some cases it will be an intense sore mouth, in others a general bowel disturbance, and again in others, loud and difficult breathing.

Lesions.—Post mortem lesions, show beards in the mouth, stomach and windpipe. A roll of beards may form and get down by the side, or at the root of the tongue, and penetrate the mucous membrane. The animal cannot get rid of them and the parts become intensely swollen and inflamed, interfering with eating and starvation may occur. Plugs of beards may lodge at any point between the larynx and bronchi, producing loud distressed breathing and coughing. In the stomach there may be a slight inflammation of the lining membrane, and if the beards lodge in the membrane and do not soften and pass away, the inflammation is severe.

Treatment.—When the mouth becomes inflammed, the treatment is

the same as in simple stomatitis. Plugs of beards when lodged in this part of the digestive tract can be removed. If lodged in the air passages or stomach, they cannot be removed, and the animal dies from suffocation or an inflammation of the parts.

EFFECT OF EATING COCKLE-BURRS.

Numerous articles have appeared in the swine breeders' journals and agricultural papers indicating that young cockle-burrs were poisonous to hogs and calves. While the cockle-burr is young and only three or four inches high it is very fleshy and tender, and relished by stock. The claims of poisoning of stock attracted sufficient attention that the Indiana Experiment Station made a chemical examination and a feeding test to determine the poisonous properties, but in both the results were negative. The young plants, stripped of the burrs, were fed to calves, pigs, rabbits and guinea pigs. These were allowed all they would eat. In no case was any untoward effect noticed. We have been called upon to post-mortem some animals claimed to have died from such poisoning, and in all cases death was due to the burrs. A few burrs would be swallowed with the young plants, and their horny prickles would irritate the stomach wall and cause inflammation, which finally terminated in death. In three cases the burrs lodged in the throat and could not be expelled.

SCOURS IN YOUNG PIGS.

Causes.—Young pigs kept in damp, dark, dirty pens are more susceptiable to this disease than if kept in clean pens and allowed plenty of exercise, pure air and sunshine. Scours is often caused within the first few days after birth by the feverish condition of the mother affecting the character of the milk. Fermented foods, slops, moldy corn, etc., when fed to the sow will also cause her to give toxic milk. Chilly damp weather, getting out in the wet grass when young, and artificial feeding are most frequent causes. Some outbreaks seem to be due to a germ, as is the case in calves and lambs.

Symptoms.—These may set in so soon after birth that it would seem as though the pigs were born with the affection. When delayed until

the pig is a few days or a few weeks old, the scours are generally preceded by constipation. The symptoms of the trouble are loose evacuations, grayish in color, which become more and more watery as the disease progresses. The young animal may show some evidence of abdominal pain. The tail and hindparts soon become soiled with the discharges. The appetite may be good at the beginning, but is gradually lost and the pig becomes dull and weak. The back is arched, hair rough, and there is an indisposition to move about. When the symptoms set in soon after birth, the disease is more apt to prove fatal than if the pigs are several weeks old.

Treatment.—Scours being a disease due largely to bad dietetics and hygiene, the preventive treatment is of more importance than the medicinal. This consists in correcting errors in feeding and care. At the time of farrowing the sow should be fed a light, easily digested ration, the pen kept clean and dry and the pigs allowed plenty of exercise and pure air. If the scours are due to a feverish condition of the mother or to irritating food, she should be given two or three ounces of castor oil. To check the scours in the pigs, a few drops of laudanum can be placed on the tongue, or a large dose (from one-half to one tablespoonful) administered to the sow. This should be repeated if necessary.

DIARRHEA. SCOURS. DYSENTERY.

Causes.—Sudden changes in the feed, especially to green feed will frequently cause it. Diarrhea may occur as a symptom in inflammatory diseases of the digestive tract.

Symptoms.—Diarrhea in hogs is characterized by frequent and rather fluid exacuations.

Treatment.—When scours occurs as a symptom of disease, the cause must be removed before we can hope to treat it successfully. In all cases it is best to give a cathartic; castor oil (one to three ounces) or calomel (one to ten grains.) This should be followed by laudanum (half a tablespoonful), prepared chalk (one-half to one tablespoonful) or nitrate of bismuth (one teaspoonful). When any one of these drugs is used, the dose should be repeated as often as necessary.

CONSTIPATION.

Causes.—Constipation is caused by dry feed, lack of water, fever,

paralysis, or it may occur as a symptom of inflammation of the intestines.

Symptoms.—This is the opposite condition from diarrhea.

Treatment.—This consists in giving a cathartic of castor or linseed oil. Epsom salts may also be given. The action of the cathartic can be assisted by an enema. Sloppy food should be fed.

PERITONITIS.

INFLAMMATION OF THE PERITONEUM.

Causes.—Hogs are not as subject to peritonitis as most other domestic animals. It results from the extension of the inflammation from the intestines or other internal organs. Injuries to the walls of the abdomen, exposure to cold, and such operations as spaying and castrating may cause it.

Symptoms.—These resemble those seen in inflammation of the bowels. The history of the case may help us in the diagnosis. The hog is feverish and dull, the back is arched, abdominal walls rigid and the breathing short and quickened. There are indications of abdominal pain.

Treatment.—The treatment is mainly preventive. Such operations as castration, spaying, etc., should be performed under antiseptic precautions. Wounds involving the abdomen are serious and should be carefully treated. Medicinal treatment is of little use.

DISEASES OF THE LIVER.

Yellows. Jaundice.

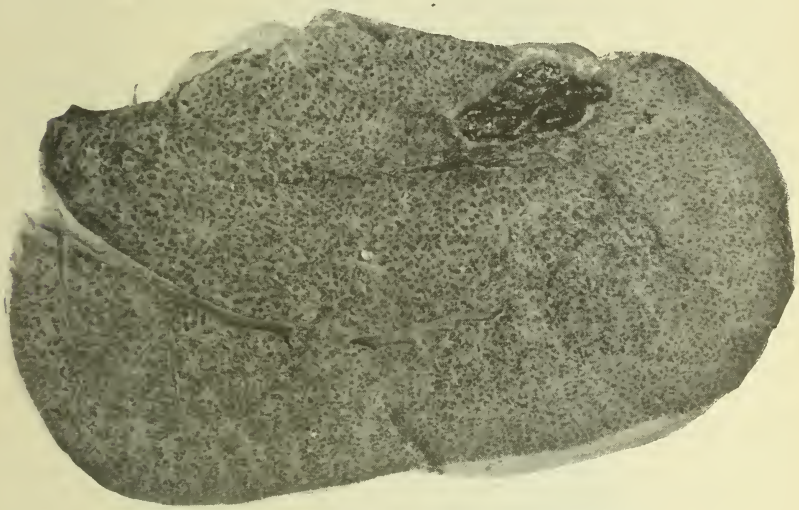
This is not a disease in itself but rather a symptom of disease, and is frequently associted with the following diseases: gall stones, parasitic diseases of the liver, inflammation of the intestines and bile duct, and congestion and inflammation of the liver. It is difficult to diagnose liver diseases in the hog, and quite impossible to differentiate one from another. For this reason it is best to discuss all liver diseases under the one head, jaundice.

Causes.—Gall stones are occasionally found in the hog and resemble fine sand in appearance. They may, however, occur as small calculi. The causes of gall stones are concentration of the bile, its becoming infected by bacteria, lack of exercise and over feeding.

Liver flukes and round worms may obstruct the bile duct as they

pass up from the intestines.. The former parasite is rare in this country and is seldom the cause of liver diseases in hogs. The round worms are sometimes found in the gall duct.

Inflammation of the bile duct may occur as a complication of indigestion or a catarrhal inflammation of the intestines. The main causes, however, are overfeeding, lack of exercise and decomposed food.



Pigmented liver. The liver is filled with dark spots.

Inflammation of the liver is frequently met with in infectious diseases. It may occur as a complication of indigestion. Certain micro-organisms entering the digestive tract with the food and finding their way to the liver may cause it to become inflamed.

Symptoms.—Any condition raising the pressure in the bile ducts or lowering the pressure in the blood vessels of the liver will cause the bile to be taken up by the circulation and carried to the different tissues of the body, staining them a yellow color. This is quite noticeable in the areolar tissue beneath the skin and in the fat, a condition sometimes met with in apparently healthy hogs killed in the abattoir. A staining of the visible mucous membranes and the skin cannot well be observed in the hog. Sometimes the coloring matter of the bile is present in the urine and the normal function of the kidneys is disturbed. Constipation usually

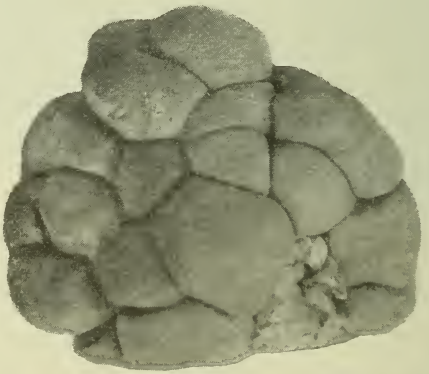
occurs and the feces have a more disagreeable odor than normal. When occurring as a complication of other diseases, the liver symptoms are usually overshadowed by the original disease.

Treatment.—The treatment is about the same as in indigestion. As a cathartic, calomel can be administered in from one to ten grain doses and repeated every other day for a few days.

DISEASES OF THE URINARY APPARATUS.

CONGESTION OF THE KIDNEYS.

Causes.—Congestion of the kidneys as a result of injury is not uncommon in hogs. Blows and kicks in the region of the back, or injuries occurring as a result of their piling up on each other, are among the common causes. Exposure, and wet, cold quarters, as in other domestic animals, may also cause it. It may occur as a complication of some infectious disease.



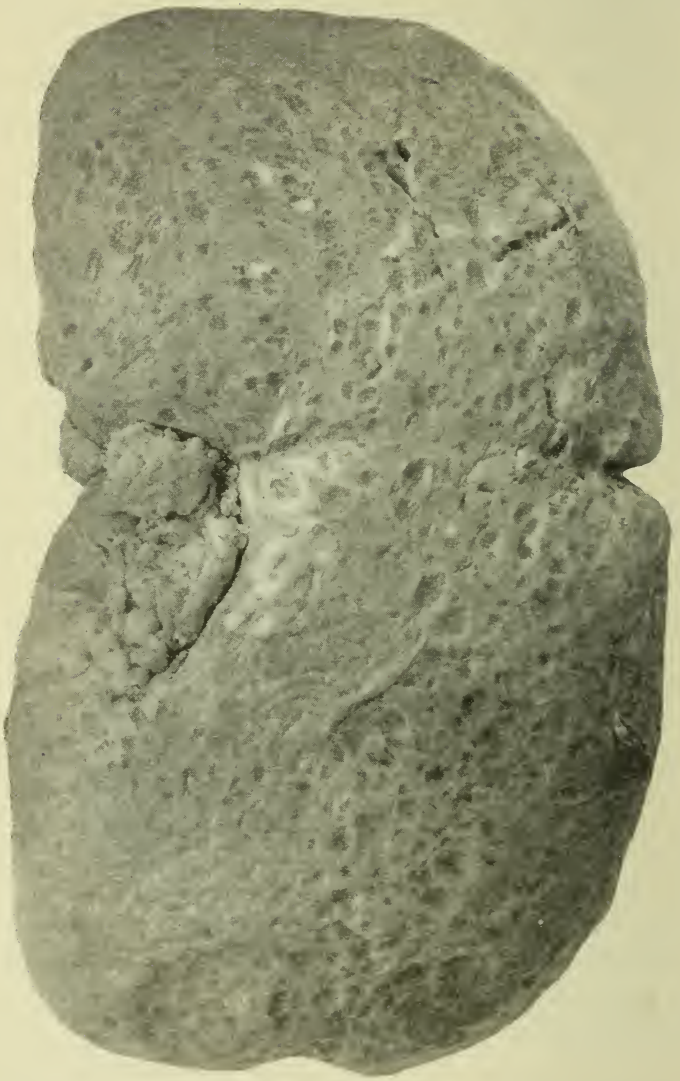
Contracted kidney. The kidney is reduced in size, is lobulated and hard. It is due to chronic inflammation of the fibrous structure.

Symptoms.—The pig shows a disposition to lie down most of the time. The hind parts are moved stiffly and the gait is stiff and straddling. Urine is passed frequently and in small quantities. It is higher colored than normal and may be tinged with blood. If due to an injury, these symptoms appear soon after it has occurred.

Treatment.—Preventive measures consist in avoiding as much as possible conditions that may cause the disease. The hog should be given dry,

comfortable quarters and fed on slops. It is well at the beginning to administer a cathartic of castor oil (one to four ounces). Hot water fomentations may be applied to the back and loins.

Tumor of the kidney.



Enlarged kidney. When cut through it shows cavities filled with urine. Due to chronic inflammation.

INFLAMMATION OF THE KIDNEYS.

Causes.—These are very much the same as in congestion of the kidneys, Irritating foods, such drugs as turpentine given internally and applied locally, and pathogenic germs conveyed to the kidneys by the circulation, or entering the kidneys by way of their excretory apparatus are frequent causes.

Symptoms.—The back of the hog may be quite sensitive to pressure. When it stands, the back is arched and held stiffly. The temperature may be elevated, the respirations and pulse beats quickened, and the urine is scant and highly colored. Convulsions may occur. Chronic inflammation of the kidneys may develop very slowly without giving rise to any noticeable symptoms until the disease reaches the later stages. Large abscesses are occasionally found in the kidneys of hogs apparently in perfect health when killed.

Treatment.—The preventive and medicinal treatment is much the same as in congestion of the kidneys. To insure free action of the bowels small doses of castor oil (from two to four tablespoonfuls) should be administered frequently. Diuretics should also be given.

DISEASE OF THE BLADDER.

Retention of the urine and inflammation of the bladder (cystitis) is sometimes met with in the hog. The retention of the urine may be due to spasms of the neck of the bladder, a cystic or urethal calculus, or from a tumor pressing on the urethra and preventing the flow of the urine from the bladder.

Treatment.—The treatment in both diseases is to remove the cause if possible. Inflammation of the bladder is due to retention of the urine and irritation from bacteria. To relieve the irritation, chlorate of potassium in from fifteen to thirty grain doses can be given twice daily. Pressure on the urethra by the tumor can be relieved by an operation in some cases. Keep the animal quiet and feed mostly sloppy food.

DISEASES OF THE SPLEEN.

Inflammation of the spleen is frequently mentioned in the older works on veterinary medicine, and an elaborate line of symptoms is sometimes given in connection with the disease.

Hypertrophy, atrophy and rupture of the spleen is recognized only by a post-mortem examination. These conditions may arise from an injury or the extension of inflammation from neighboring parts. Splenic hypertrophy is frequently seen in connection with high feeding and infectious diseases. Tumors of the spleen may cause it to become larger than normal.

DISEASES OF THE RESPIRATORY TRACT.

NASAL CATARRH.

Cold in the Head.

Causes.—Exposure to cold, especially if in an overheated condition or when the body is wet by rain, is the most common cause of catarrh. Hogs overcrowded in pens or allowed to sleep around straw stacks or manure heaps are apt to suffer as a result of overheating and becoming chilled, or by irritation from the dust and noxious gases generated under such conditions. This is especially true during the cold, wet weather when they pile up to keep warm.

Symptoms.—The hog may act dull, the body temperature may be elevated, and the eyes appear red and watery. The nasal mucous membrane becomes red and dry and the hog sneezes frequently. This dry stage lasts for a short time and is followed by a watery discharge from both nostrils, and in the more severe cases this is succeeded by a thick whitish or yellowish discharge. If this continues for some time the mucous membrane becomes markedly changed and ulcers form. Severe outbreaks are known as malignant catarrh. Nasal catarrh does not run a well defined course and may extend to other parts of the respiratory tract.

Treatment.—In the simple form of the disease medicinal treatment is not necessary. The hog should be fed warmed slop for a few days and a laxative (castor oil) administered. In severe cases in addition to this, inhalations of medicated steam (turpentine or creolin) may be given.

PHARYNGO-LARYNGITIS.

Sore Throat.

The causes and symptoms of inflammation of the pharynx and larynx in the hog are very much the same. This is also true of tonsilitis, and usually, all of these structures are involved at the same time, and can be discussed conveniently under the one head, sore throat.

Causes.—Sore throat frequently occurs as a complication of a bad cold. In addition to those already mentioned as causes of cold in the head are wallowing in cold springs and creeks when warm, being deprived of water and slops during a warm, dry season, close filthy pens, debility, entrance of septic germs along with the food and germs of hog cholera and swine plague.

Symptoms.—There is more or less fever, the eyes are red and watery and the animal is dull and may lie around the pen most of the time with its head buried in the litter. The appetite is poor and the hog may refuse food, because of the pain and difficulty in swallowing. Sometimes there is considerable restlessness. The respirations are noisy and the throat swollen. The cough may be dry, hard or spasmodic in character, often quite hoarse. There may be a discharge from the nose or mouth. In septic poisoning in the food and in infectious diseases, false membranes may form or the mucous membrane become gangrenous. The disease may develop rapidly and the air passages become closed by the swelling in a few hours and the pig die. Sometimes the animal dies as a result of the local ulceration or from general infection. In the less severe cases the disease runs a course of a week or more. In this latter form, if not caused by pathogenic organisms, recovery usually occurs.

Treatment.—The sick hog should be isolated from the healthy ones and given clean, dry, comfortable quarters. This part of the treatment is very important if the inflammation is due to septic organisms. Sloppy food should be fed and in cold weather it is best to feed it warm. Mild stimulating liniments can be applied to the throat. Sometimes a blistering ointment (powdered cantharides one part and vaseline eight parts) is applied to the skin in the region of the throat. An electuaria made of syrup three ounces and tincture of aconite two drams, can be given in teaspoonful or tablespoonful doses thrice daily. By confining the hog with a noose around the upper jaw the throat can be swabbed out with antiseptic washes (silver nitrate one part, water one hundred parts), or permanganate of potassium (two parts, water ninety-eight parts.) It is best to make the handle of the swab of wire or the hog may bite it in two. In acute attacks, or when the inflammed parts become gangrenous, treatment is of no use.

BRONCHITIS.

Causes.—These are the same as in common cold or sore throat. Bronchitis is frequently caused by irritation from dust or parasites.

Symptoms.—In the acute form the body temperature is elevated and the appetite impaired. The breathing is usually distressed and coughing frequently occurs. The disease does not run a definite course and may become chronic if the exciting causes are kept up. When this occurs, the pig does not thrive as it should and if the air passages are irritated in the least by dust, etc., it will cough violently. Coughing is especially prone to occur upon leaving the bed or after exercise. Pigs seldom die of this affection.

Treatment.—This is largely preventive. Good food and care are about all the treatment necessary.

PNEUMONIA.

Causes.—It is not uncommon for the inflammation to extend from the air passages to the lungs and the animal have a serious attack of pneumonia. Plethora is the principal predisposing factor. Among the exciting causes can be mentioned fatigue and impure air. In young hogs the lung worm will frequently cause a lobular pneumonia.

Symptoms.—Pneumonia may come on quickly, beginning with a chill and attended with a high fever, or as a complication of some other respiratory disease. The hog will remain down most of the time, hiding under the litter and will eat nothing or but very little. The respirations are hurried. Exercise is followed by marked exhaustion, sometimes by death. The cough is at first deep and dry, later more moist. During the first stage of the inflammation, the period of congestion, the cough may be accompanied by hemorrhage. Other symptoms will be revealed in thin, quiet hogs by placing the ear to the side of the chest and listening to the lung sounds (ausculatation). In the very earliest stage of pneumonia a crepitating sound may be heard in the diseased area, later when the engorgement of the air cells occurs, the healthy murmurs and the crepitating sounds are deadened. When the lung tissue is returning to the normal state, the crepitating sounds can again be heard. The disease may

involve one lung or part of both. The chances for recovery are better in lean than in fat hogs, as the disease is usually less severe. The attack runs a course of from ten days to two or three weeks.

Treatment.—The hog should be given a comfortable pen and kept as quiet as possible. If it will eat, a light sloppy diet should be fed. To keep the bowels loose, from one to three ounces of castor oil can be administered occasionally. As a counter-irritant to the sides of the chest the following liniment can be used; oil of turpentine ten parts, croton oil one part. If the heart action is weak, from five to ten drops of tincture of digitalis should be given every three or four hours. During the colvalescent stge, if the animal appears weak, alcoholic stimulents can be given.

PLEURISY.

This is an inflammation of the membrane lining the chest cavity and covering the lungs.

Causes.—Pleurisy may develop during the course of pneumonia. Sudden chilling of the body, especially if overheated, exposure to cold and damp pens are common causes. It may occur in the different contagious diseases (hog cholera, swine plague, and tuberculosis).

Symptoms.—The early symptom of the disease is chilling. Sometimes the hog is lame in one or the other of the fore legs and appears stiff when it walks. The appetite is poor and the hog is restless or lies down most of the time. The breathing is highly characteristic. The ribs are held rigid and the respirations are short and jerky, the movement being noticed mostly in the flank. The body temperature is higher than normal, the pulse quickened and the cough rather surpressed. Pain is a very prominent symptom. When the sides of the chest are pressed upon with the hand the hog will flinch, sometimes grunt or squeal. On auscultation friction sounds are heard. In case there is an outpouring of fluid into the chest cavity (hydrothorax) these sounds are not heard and all respiratory sounds toward the lower part of the chest are deadened. If much fluid accumulates in the chest cavity, the symptoms of pain are diminished, but the respirations are more labored and the pulse weaker. Toward the later stage of the disease, the hog is greatly depressed. When made to get up, it may squeal. Frequently, it is seen lying on its side as though it

were dead. The course of the disease is from one to two weeks. In mild cases and when only a part of the pleura is involved the symptoms are less severe.

Treatment.—Good care at the beginning of the attack will help in aborting it. The hog should be placed in a warm, clean pen and made as comfortable as possible. In a warm pen and when the hog is quiet, warm packs can be applied to the sides of the chest and the hog covered with a blanket. The medicinal treatment does not differ greatly from that recommended in pneumonia. A teaspoonful of syrup of squills and from three to six drops of tincture of aconite can be given three times daily. Sulphate of quinine, five to twenty grains, and nitrate of potassium, ten or fifteen grains, can be given every four hours. The same blistering liniment as recommended in pneumonia can be applied to the walls of the chest. It is best to administer a physic early in the attack, and feed the hog a light sloppy diet.

DISEASES OF THE HEART.

Diseases of the heart are not uncommon in the hog. Inflammation of the lining membrane (endodcarditis) and the covering of the heart (pericarditis), and sometimes inflammation of the heart muscles is met with in pleurisy, pneumonia, rheumatism, hog cholera, swine plague and other diseases.

Symptoms.—These are high temperature, depression, severe pain and palpitation. Occurring as they do as complications of some other disease, they are usually over-shadowed by the original disease.

The prognosis is unfavorable.

FATTY DEGENERATION OF THE HEART.

Causes.—Fatty degeneration of the heart is due to overfeeding and lack of exercise. The fat accumulates in masses around the heart and in the muscular tissues, the natural structure being replaced by fatty granules.

Symptoms.—In this disease, the heart action is weak and irregular. The hog is unfit for any kind of exertion and may die suddenly if this is attempted. Palpitation may occur.

Treatment.—The treatment is wholly preventive and consists in avoiding such conditions as may cause the disease.

PALPITATION. SPASM OF THE DIAPHRAGM. THUMPS.

True palpitation is a sudden violent beating of the heart not connected with any structural disease of the organ. It sets in suddenly, the cardiac sounds are louder than normal, the beats are quickened and the animal may be restless and appear anxious. This affection sometimes occurs during the course of some digestive disorder. Excitement and exercise may also cause it.

Spasm of the Diaphragm is quite common in pigs. Digestive disorders, especially overloading of the stomach and lack of exercise, are the main causes. A number of pigs in the litter or in the same pen may become affected at the same time. This is especially true of litters not given sufficient exercise.

Symptoms.—There is a sudden jerking movement of the flank. When the pig is standing quietly, this is very noticeable, and may be of such violence as to move the body backwards and forwards. It may be accompanied by a sound that can be heard some distance. These contractions are not rhythmical, but occur more frequently at one time than at another. After exercise the jerking is violent, and after a full meal, is more pronounced than when the stomach is empty. Thumps interfere with the pig's appetite to a certain extent and they do not thrive, becoming stunted in some cases. Sometimes they lose flesh quite rapidly and become very thin. The course of the disease is from a few days to several weeks.

Treatment.—Exercise alone will generally effect a cure. When the disease develops in a litter, they should be turned on pasture and given plenty of opportunity to run around. If this cannot be done they must be given exercise in some other way, as placing them in a pen or box away from the mother. From three to fifteen drops of of tincture of opium can be administered in a little oil every three or four hours to give relief. It is well to administer a physic of raw linseed oil at the beginning of the trouble.

DISEASES OF THE NERVOUS SYSTEM.

CONGESTION AND ANEMIA OF THE BRAIN.

Causes —In congestion, the blood vessels of the brain become engorged with blood. Fat, plethoric hogs are predisposed to this condition. The exciting causes are sunstroke, exertion, tumors and parasites pressing on the brain, and blows on the head. Congestion may occur as a complication in some of the infectious diseases.

Anemia of the brain is due to an insufficient amount of blood in the brain, and may be caused by a weakness in the heart action or severe hemorrhage.

Symptoms.—These generally come on very suddenly. The hog shows symptoms of excitement and sensitiveness, or appears dull and drowsy. Death may occur in a short time. Apoplexy due to rupture of capillaries in the brain sometimes occurs, and the disease tends to merge into an inflammation of the brain.

Treatment.—Place the hog in a cool place and apply water or ice to the head. Bleeding at the beginning may be followed by good results. As a purgative, four or five ounces of linseed or castor oil can be given. The after treatment consists in keeping the hog quiet and in a cool comfortable place. In anemia of the brain, the medicinal treatment is along the line of stimulants, and cold applications to the head are contra-indrdeated.

ENCEPHALITIS.

Inflammation of the Brain and its Membranes.

Causes.—As causes of this disease can be mentioned high temperature as in summer, unusual exercise, sudden changes in the feed, overfeeding, parasites (cysticercus), unsanitary conditions and injuries to the head. Inflammation of the brain occurs in some infectious diseases. It may follow a congestion of the brain.

Symptoms.—They usually set in abruptly, the hog apparently in perfect health will within a few hours manifest serious symptoms of a nervous character. The disease is usually ushered in by a period of dullness. In some cases, however, the hog appears nervous and excited from the first. During the period of excitement or delerium, the hog champs its

teeth, froths at the mouth, walks or runs about the pen, generally in a circle and without showing much ability to dodge obstructions. It will squeal or grunt, try to climb up on the sides of the pen, press its head against the wall or fence, and finally fall over in a convulsion. It may regain its feet in a short time or lie in a stupor which usually ends in death. The gravity of the disease cannot always be judged by the frequency and violence of the attacks, as often when the hog is sleepy and drowsy from the first, it rapidly proves fatal. The course is usually short and the prognosis unfavorable.

Treatment.—A large dose of salts should be given early in the attack. Bleeding and cold applications to the head prove of some value by lessening blood pressure in the brain. The pen should be dark and cool. When the disease terminates in paralysis, iodide of potassium, twenty grains, and tincture of nux vomica, ten or twenty drops, can be given in a few ounces of water three times a day.

APOPLEXY.

Apoplexy may occur in hogs that are in a very fat condition and is due to a rupture of a bloodvessel in the brain. It sometimes happens as a result of congestion of the brain. When this accident occurs, the hog drops suddenly, becomes unconscious and is usually dead in a short time.

VERTIGO.

Blind Staggers.

Vertigo may be associated with diseases of the brain and its membranes, such as anemia, congestion, tumors and parasites (cysticercus), especially the latter.

Symptoms.—These are attacks of blindness, jerking upward with the head, turning in a circle or rotating on the long axis of the body, running straight ahead and finally falling on the side or rolling over and over. When due to parasites, the hog turns to the side on which the parasite lies and the attacks are apt to occur at any time.

EPILEPSY.

Spasms, Fits.

This disease is characterized by sudden loss of consciousness, convulsive movements, etc. In the intervals between the attacks the hog may appear in good health.

Causes.—Epilepsy may be due to lesions in the spinal cord or brain. It is sometimes transmitted fro mthe parent to the offspring and in-breeding is also thought to cause it. Intestinal worms are probably the most common cause of spasms in young pigs. It may also occur as a result of dentition.

Symptoms.—The pig may be restless previous to the attack. The convulsive contractions generally begin in the muscles of the head and extremities. Jerking of the muscles of the face, champing of the jaws and an unsteady gait is noticed at first. Suddenly the pig falls, consciousness is lost, the limbs are extended and the seat of convulsive movements, the head may be thrown back, saliva runs from the mouth and urine is passed. Because of the respiratory muscles being involved, the animal has great difficulty in breathing. In mild cases the convulsive movements are feeble and may cease in a few seconds. Usually the attack lasts a few minutes. The hog may get up and act as though nothing had happened or act dull and sick for several days. There is some danger of the pig dying in an attack. Sometimes during a seizure, the other hogs in the pen will kill it.

Treatment.—The spasm may be stopped by throwing cold water on the pig's head, or better by immersing its body in warm water. The pig should be kept as quiet as possible between attacks. A cathartic of castor oil should be given. Until the stupor has completely passed, it is best to give from half a dram to a dram of bromide of potassium in the feed or drench twice daily. As soon as it acts well, it can be turned out with the rest of the herd.

CHOREA.

This affection is commonly seen in young pigs, but may develop at any age. The causes of the disease are not definitely known. It is more commonly seen in weak, poorly developed or deformed pigs, specially those

having a bulging forehead and showing a tendency toward hydrocephalus.

Symptoms.—Chorea is characterized by spasmotic movements of some part of the body, as the head, or one or more legs. The head is most often affected, and is jerked to one side and may be accompanied by wry neck. The jerking occurs in quick succession, or there may be considerable interval between jerks. The attacks may become spasmotic, that is, very bad part of the time and only slightly so at other times. The jerking takes place more or less constantly during the waking hours. If a leg be affected, it will be drawn up and put down suddenly, keeping up the motion more or less constantly while standing. There will also be some twitching when lying down and not asleep.

Often when pigs are so affected, although in good condition when the trouble begins, they become thin and puny.

Treatment.—The best treatment is to turn the affected pig out on clover pasture and give it plenty of milk. As the animal grows, it may gradually get better without medicinal treatment. Good results may follow the administration of tincture of asefoetida in half tablespoonful doses two or three times a day.

SUNSTROKE OR HEATSTROKE.

Hogs, especially fat hogs, when driven on a very hot day, or handled and shipped some distance are apt to be overcome with the heat. If kept in a pasture unprovided with shade, they may suffer severely from the sun.

Symptoms.—The principal symptoms are fatigue, dropping of the ears, staggering gait, sudden collapse and unconsciousness and death. Convulsions may occur and death generally follows in a short time.

Treatment.—The preventive treatment consists in not handling fat hogs during the hottest part of the day in the very warm weather, and providing the hog pasture with some shade. When handling hogs in hot weather, frequent wetting with cold water will help in keeping them cool. If overcome by the heat, it is best to move the hog to a shady place and pour cold water on the head, but not upon the body. As a stimulent, alcohol (one tablespoonful) or tincture of nux vomica (one teaspoonful), can be given in a little water.

PARALYSIS OF THE POSTERIOR PART OF THE BODY.

Causes.—Small centers of inflammation in the spinal cord due to injuries in the region of the back will cause a paralysis of the hind parts. Pressure on the cord from tumors, parasites (cysticercus), or an over fat condition will also cause it. It is not uncommon for paralysis to occur among a number of hogs in a pen or when shipped in cars or in a crate. Lack of exercise, indigestion and constipation are said to cause this condition. This disease is usually called "kidney disease."

Symptoms.—The paralysis may develop suddenly or come on gradually and nearly always involves both hind legs. When the disease develops slowly the first symptom noticed is an unsteady gait, the hind legs do not follow exactly in line with the front ones, become crossed, or instead of walking directly forward, the body appears to go sidewise. After lying down there is more or less difficulty in getting up. These symptoms become progressively worse until the hog simply drags the hind parts. If the paralysis develops suddenly, the pig is found dragging the hind parts and unable to get up on the hind legs. The appetite is usually good in the early stage, and may remain so. Pressure over the affected region does not cause the animal pain, but sometimes it will squeal when moved. The appetite may become poor and the bowels constipated, depending upon the extent of the lesions. If recovery does not take place within a few days or a week, the case is not apt to terminate favorably.

Treatment.—This consists in moving the hog to a comfortable pen where it can not be disturbed and feeding it mostly on slopy food. It is very necessary that no dry feed be given in order to prevent constipation. Early in the disease a cathartic of Epsom salts should be given and repeated if necessary. This may be supplimented with an enema of water and glycerine. From five to ten drops of tincture of nux vomica should be given two or three times a day. Counter-irrritation along the back by means of blistering liniments (oil of turpentine ten parts, croton oil one part), or the firing iron can be used. Dr. Peters, of Nebraska, recommends the firing iron. To fire the back of a hog, number sixteen wire can be used. There should be fifteen or sixteen pieces about a foot in length pointed at one end. The pointed end should be placed in a charcoal or corn cob fire and heated to a white heat. When ready for

use, they can be held in a pair of pincers, and the skin punctured at points an inch or two apart in the region of the loins. The wires should be allowed to pass through the skin and into the tissue beneath, or the operation will not give satisfactory results. The hog should not be forced to walk, as this will retard recovery. After the animal is able to walk, kepe it away from other pigs for a few weeks.

DISEASES OF THE GENERATIVE ORGANS.

STERILITY. BARRENNESS.

Sterility may exist in the male or female and may be temporary or permanent. Some years the per cent. of barren sows is very large.The cause for the condition has not been ascertained.

Causes —In the male impotency is sometimes a functional trouble, due to improper development of the sexual organs or a broken copulatory organ. Other causes are a fatty degeneration or infiltration of the testicles, lack of physical or functional exercise and old age.

In the female, sterility may result from a greater variety of conditions than in the male. Excessive fattening, as is sometimes seen in sows fitted for exhibition purposes, will cause it. This may be due to the ovaries becoming so infiltrated with fat as to interfere with their function, or to an occlusion of the passages with fat. In the former case the change is often so great that nothing will insure a complete return to the normal, but in the latter the function can be restored by reducing the condition of the sow. Sometimes a rigid os prevents the entrance of the seminal fluid into the womb. Such a condition may occur in young or aged sows. Inflammation of the lining membrane of the uterus or vagina may also cause it. In this condition a discharge, usually so slight as to escape notice, occurs, and when the male element comes in contact with the abnormal secretions, it is destroyed. In old age barrenness occurs.

Faulty development of the generative organs is not uncommon in sows. The uterus may be abnormally small, the ovaries rudimentary and the vagina and os imperforate. In these cases, the sow may never come in heat and never conceives.

Treatment.—Excessive fat is a frequent cause of sterility in both the male and the female and must be overcome by dieting and exercise. The

male should not be used to excess and should be kept in a healthy, vigorous condition. If the os is rigid and closed, preventing the entrance of the seminal fluid into the womb, it should be dilated. Closure of the maternal passages by fat can be overcome by a proper diet and plenty of exercise.

ABORTION.

Abortion or slipping of pigs is a troublesome problem with which to deal. There seems to be two varieties in these animals, the same as in the other domestic animals, sporadic and infectious. The sporadic form is the variety most often met with and is due to accidents, as slipping, falls, being kicked by a horse, or hooked by a cow, by being run by dogs, or worried by other sows in heat, or by a boar, to spoiled or musty food, to "piling up" in bed, to sudden exposure to cold and to the effects of some other disease, as cholera. It can readily be observed that these causes will not as a rule act upon many sows in the same herd with sufficient violence to cause abortion, as the sow does not abort easily. After an outbreak of cholera we expect a considerable percentage of abortion. While an infectious abortion of the sow has not been described, the Station has been the recipient of several accounts of such trouble that could not be accounts for upon any other hypothesis. In these cases a greater or less percentage of the herd would be affected, and, like barrenness, the trouble is much more frequent some seasons than at others.

Symptoms.—The symptoms of abortion when due to accidental causes are great uneasiness, shivering, making of a bed, violent straining and groaning. The parts are unprepared for the accident and therefore is associated with considerable pain and occupies several hours. If the abortion occurs within the first two months a discharge of blood and a macerated foetus and membrane are all that will be found. After two months the foetuses will be entire. In some cases there will be a loss of appetite and an indisposition to move about for a few days, while in others the disturbance is so slight as to be scarcely noticeable. In the infectious form of the disease the genital tract seems to be prepared and there is less disturbance than in normal labor, and unless the swollen genitals and

the expelled foetuses are seen, the first warning of such an accident may be the recurrence of heat. Infectious abortion seems to occur most frequently at the end of the second month.

Treatment.—Very little can be done to arrest the act and without knowing the cause it is hard to prevent. It is a wise measure in all cases to remove abortion sows from the herd upon the assumption that it may be infectious and that the presence of such an animal may be a menace to others.

MAMMITIS. GARGET.

Causes.—Inflammation of the udder may occur in heavy milkers, due to the fact that all of the milk is not drawn. This condition may exist when a part or all of the litter dies. Obstructed teats will sometimes cause it. Following a difficult case of parturition the udder will sometimes become inflamed.

Tumors of the mammary g'ands.

Treatment.—Remove as much milk as possible and bathe the udder with hot water for twenty minutes several time a day. Knead the parts thoroughly. As a local application use a dram each of tincture of belladonna and spirits of camphor in two ounces of lard; rub well when applying it. A cathartic of Epsom salts or castor oil should be given every other day until the condition is relieved. When the teats are sore, they

should be bathed once a day with white lotion (one part zinc sulphate, three-fourths of a part lead acitate, thirty parts water) until healed.

DISEASES OF THE SKIN.

URTICARIA.

Causes.—Unhygienic conditions and irritation to the skin from lice and drugs are frequent causes of urticaria. Young pigs are predisposed to this class of skin diseases, and it may be seen in the different specific diseases, as cholera and swine plague.

Thick, rough skin due to prolonged exposure in a wet cold place.

Symptoms.—The blotches come on the skin very suddenly, usually in the night and appear as red, hot, swollen spots that may run together and become very large. The spots are seen on almost any part of the body. On account of the itching, the hog will scratch and rub the part and the surface may become abraided. In the light cases, the trouble will pass off about the second day without the formation of pustules. In the more severe form, pustules develop and it requires a week or more to make a recovery. The appetite is usually impaired and the hog is feverish. This disease is not contagious.

Treatment.—Two or three ounces of Epsom salts should be given in the feed, and the hogs fed a light sloppy diet. If dirty or lousy, they should be dipped or washed with a watery solution of some of the cresol preparations. In severe cases ten drops of Fowler's solution of arsenic should be given twice daily.

ECZEMA. PITCH MANGE.

Causes.—This disease is associated with unhygenic conditions, filthy pens, extremes of heat and cold, and a debilitated condition. It may also occur in specific diseases (hog cholera, articular rheumatism, etc.). What seems to be a variety of this form of mange, occurs upon marsh land in the summer, when dry, due to the irritation of the soil—itch dirt. This is seen frequently in the Kankakee region.

Symptoms.—The disease starts by small red spots on the skin. These are followed by vesicles (blisters) which in time becomes pustular. Finally these dry up and form thick crusts which gradually wear down and become thin and branny. All stages of the disease may be seen on the skin at the same time. There is intense itching and the hog may have a slight fever, a poor appetite and act dull.

Treatment.—This consists in bettering the hygenic conditions under which the hogs are kept, and either washing or dipping them in a water solution of some of the coal tar preparations. The washing or dipping should be repeated at frequent intervals.

SKIN WARTS.

Warts are simply piled up epidermal cells and are best removed with

a knife. A preparation of a dram of salicylic acid in an ounce of castor oil, rubbed on once or twice a day for a couple of weeks may remove them.

SORE TAILS.

Causes.—The causes of sore tails, and tails dropping off, are cold, filth and injuries. When young the tail may become injured by the mother stepping on it. Sometimes when the pen is filthy bacteria will

Pitch mange due to "itch dirt."

cause it. Old hogs, when allowed to wallow in the mud, may loose a portion of their tails from the mud balls that accumulate toward the ends. Loss of the tail is frequently associated with an unthrifty condition.

Treatment.—This is preventive. If the pens are filthy, they should be cleaned and antiseptics used freely. The loss of the tail is of little consequence to the ordinary hog, but for those used for other purposes or to be sold as breeders, it becomes a blemish.

DISEASES OF THE LOCOMOTORY ORGANS.

ARTICULAR AND MUSCULAR RHEUMATISM.

Articular and muscular rheumatism are so frequently associated in the hog that it is best to discuss them together. Although hogs live under favorable conditions for the development of rheumatism, they do not often develop the disease. This is probably due to the protection afforded by the subcutaneous fat.

Causes.—This disease is attributed to cold, damp pens and exposure, but it may occur in hogs when well managed. Overfeeding is also said to cause it. Rheumatic symptoms are frequently noticed at the beginning of an outbreak of hog cholera.

Symptoms.—The muscles and joints may both be involved and the symptoms quite marked. There may be a fever, loss of appetite and a general lack of condition. The lameness will move about and may involve one or more of the legs. Sometimes there is considerable swelling of the hock, the knee or the joints of the foot. If the muscles of the back are involved, it is arched and very tender on manipulation. Stiffness in the gait is present, especially if the quarters are involved. The pain in the muscles and swollen, inflamed joints is intense, and the hog will sometimes squeal when the parts are handled or the joints flexed. While the hog is asleep there may be sudden contractions, indicating pain due to relaxation of muscles. On account of the pain and difficulty in walking, the hog will lie around the pen most of the time and refuse to go far for his food.

Treatment.—Preventive treatment is very important. It means the providing of dry, comfortable quarters and the avoidance of exposure. The straw stack should be avoided as a shelter for hogs. Sick hogs should

be given sloppy feed. Salicylate of soda can be given in twenty or forty grain doses three times daily. Recovery occurs in from two to three weeks. The disease may become chronic.

RACHITIS, OR RICKETS.

Causes.—This condition is due to a lack of development of the bones. The mineral matter is not deposited in the normal proportion. It is seen in growing pigs after weaning. It most often occurs in those that receive an almost exclusively corn diet with no milk and no pasture. It is seen more often in winter than in summer because the conditions enforce the penning and feeding of the pigs at that season. It is also seen in some litters which might indicate that it was hereditary.

Symptoms.—The disease is characterized by weakness of the bones, bending of the legs, breaking down upon the feet; there may be either a dropping or arching of the back, a spraddling gait, distorted face, bulging forehead, sniffles and paralysis. Such pigs are nearly always fat at the beginning. The disease does not tend to destroy the animal quickly, as it is a slowly progressing disease.

Treatment.—The treatment as far as it can be of service, is to feed less fattening food and substitute milk, oats, rye, and a little oil meal. An abundance of salt,, charcoal, wood ashes and air slaked lime should be available.

SORE FEET.

Causes.—If hogs are kept continually on hard floors or driven over hard, rough roads, the feet may become inflamed and bruised. Standing in filth may cause the feet to become sore, the moisture softening the tissue at the uper margin of the wall, in the interdigital space and at the heel.

Symptoms.—The hog flinches a great deal when it walks, goes quite lame. This is especially true of heavy hogs, and if the pain is severe, they lie down most of the time. On making a local examination, the claws may be found long and over grown or the heels and the space between the claws is swollen, sore and inflamed.

Treatment.—When caused by hard floors, simply turning them out on pasture will effect a cure. If the pens and yards are filthy, they should be changed to clean dry pens, and the feet freed from all filth and washed once a day with a four per cent. watery solution of some of the coal tar preparations; or with chloride of zinc (one teaspoonful to the pint of water). It is very necessary that the hogs be kept in a clean, dry place until well.

SNIFFLES. SNUFFLES. BULLNOSE.

It is evident from the descriptions given that all writers are not agreed upon the nature of this affection. There are two varieties of the affection—the catarrhal and the rachitic.

In the catarrhal form we have a more or less wheezing, respiration occurring at irregular intervals. There is a profuse, watery discharge from the nostrils, causing the animal to blow violently when first getting out of bed or after eating. The animal can not exercise freely owing to the difficult respiration. The attacks, which are mild and of intermittent character at first, become more severe and the condition is persistent. The discharge changes from a thin, water secretion to one containing blood, to thick mucus, and finally yellowish or purulent. Nose bleeding is frequent owing to the violent efforts to clear the nose. There is a cough, the eyes become red and the tears flow, the hair roughens and the whole appearance is "dumpish." There is difficulty in seizing, grinding and swallowing the food, owing to the soreness of the mouth and throat. The trouble runs a course of from one to five weeks and death comes from starvation or asphyxia. Those that recover nearly always remain stunted.

A post-mortem examination of such a case shows the mucous membrane lining the nasal chambers to be greatly thickened, practically blocking the air passages. The turbinates and the septum become so crowded by the uneven pressure that they are deformed. The effect is to produce a blunt, thickened, more or less twisted nose, depending upon the uneven changes in the different bones.

In the rachitic form we have essentially the same changes take place in the nose, and in addition there are changes in the bones in other parts

of the body. The legs become curved and misshapen, and often there is breaking down on the feet. Not infrequently, too, there will be bulging of the bones of the head, as in hydrocephalus.

Causes.—The cause of the trouble is not definitely known. By some all the cases are regarded as being primarily due to a lack of development of the bones in the nose, thus prdisposing to catarrhal trouble. Others consider that the trouble may be catarrhal from the beginning, due to catching cold, and that the changes in the bones are secondary. The writer is of the opinion that some cases belong to one class and some to the other.

The disease is sometimes described as being contagious, but we are not in possession of facts to justify such a statement. It is more probable that the conditions which give rise to the trouble in one pig may also affect others. It is frequently observed to affect all the pigs belonging to one litter, but I have never witnessed the trouble pass from the pigs of one litter to pigs of another. It has also been observed in four successive litters from the same mother, thus showing a hereditary tendency. There were also other evidences of rickets present.

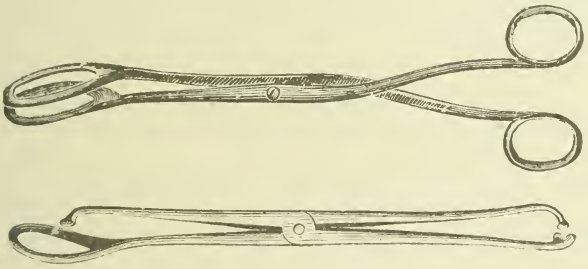
We find this trouble in pigs kept under good hygienic conditions as well as in those that are subject to exposure and poorly nourished, and it is more common in those breeds with stubby, turned-up noses than of the straight variety.

Treatment.—The best treatment is to destroy such pigs. It will end their misery and save expense. The majority will die and those that recover will not be worth feeding in nine cases out of ten. Those who wish to try to save them should put the pigs upon a good pasture and feed sweet milk. Corn should not be given, or, if it be given, there should be oil meal added to balance the ration. If pasture can not be secured, provide a dry, warm pen. Keep the bowels open as the symptoms may indicate. Fumigate with burning tar and apply tar about the feed troughs. An ointment composed of equal parts turpentine, kerosene and ammonia in sufficient lard to make it stiff has been recommended as an application to the face. This is repeated twice a week for a month.

DIFFICULT PARTURITION.

Difficult birth is not as common in the sow as it is in the larger domestic animals. This is because the pelvic cavity through which the foetus passes is large in comparison with the size of the young. A roomy pelvic cavity, however, does not always insure an easy birth, and when stacle to birth, and the tendency on the part of the owner should be not hygiene of pregnant animals, there will be plenty of cases of difficult parturition in the herd.

Causes.—The most common cause of difficult parturition in young, fat sows is a large foetus and a narrow maternal passage, a condition frequently met with when a large male is used on small sows. Other causes are malpresentatioms, monstrosities and diseases of the foetus (hydrocephalus, emphysemia, etc.). Emphysematous conditions are met with when the act of parturition has been prolonged and the foetus is dead and undergoing decomposition. The only malpresentation met with



The better forms of pig forceps.

is the transverse. In this presentation instead of the head or breech presenting, it is the side, back or belly. In prolonged parturition the maternal passages become dry and the passage of the foetus along them is greatly interferred with. In case of debility and exhaustion, the expelling powers are weak in comparison with the resistance to be overcome, and but little progress is made. A dead foetus acts as an obstacle to a rapid birth.

Treatment.—At the time of birth the sow should be in comfortable quarters where there will be no chance of her being disturbed by other animals, and where the necessary assistance and care can be given with-

out the attendant undergoing too many discomforts. The act of parturition may be prolonged and progress very slowly without their being any obstacle to birth, and the tendency on the part of the owner should be not to meddle too soon, but to wait until nature has had a fair chance. In nearly all cases the sow is quiet and in the recumbent position, and her condition can be judged by the progress made during the labor, and an exploration of the parts with the hand. Before making an exploration, the hands should be washed and the fingers smeared with vaseline. If necessary, the finger nails should be shortrened. When the hand is large and the passages narrow, the fingers are all that can be inserted. This will be sufficient to judge the condition of the maternal passages and the position of the foetus, if it has gotten as far back as the entrance to the pelvic cavity, or into the passages. The explorer should conduct his examination with all the care, attention and gentleness possible, and take time to assure himself of the true state of affairs.

After becoming satisfied as to the conditions present, we should give the required assistance. We should not go too far in assisting her, nor attempt to do what nature herself could not accomplish under more favorable circumstances. For instance, if the foetus is so large or deformed in such a way that it cannot pass through the entrance into the pelvic cavity, we must not attempt it. In case the sow is restless, she should be given a tablespoonful of tincture of opium, and if necessary, the dose should be repeated. If the parts need dilating, fluid extract of belladonna can be smeared on the os. Dry, feverish pasages can be moistened by injecting into them with about an eight ounce syringe, soapy, warm water. The further forward the fluid is thrown, the better will be the results. If the expelling forces are not sufficient to expell the foetus and there is no obstacle to birth, their force can be increased by administering to the sow from half a dram to a dram and a half of extract of ergot and repeating the dose in half an hour if necessary. We must remember, however, that this drug should not be given if there is undue resistance to birth, unless the animal is exhausted and debilitated.

If the difficulty is a malpresentation, it should be corrected with the fingers if the sow is "roomy", or with wire hooks made from number eight wire. The hooks should be crooked about half an inch, rather blunt on the end, and the shank long so that the operator can manipulate them handily. These hooks are useful in helping to extract the foetus, but are

not as handy as some of the many styles of pig forceps now on the market.

After giving the necessary aid, we should wait and watch results. If our efforts have proven unsuccessful, we must then resort to the pig forceps, hooks, etc., and proceed in extracting the foetus. If it has not already entered the pelvic cavity and the passages are narrow, our efforts may prove unsuccessful. This is very apt to be the case if the foetus is emphysematous or dead. The after treatment consists in washing out the uterus and vagina with a two per cent. watery solution of creolin.

CAESARIAN SECTION. LAPAROTOMY.

When all effort to remove the young by ordinary means fail, we can then resort to more heroic measures, that of making an opening into the uterus through the abdominal walls and extracting the foetus. In valuable breeding sows this operation is of special value, but should not be attempted by the stockman. It is useless, however, to operate when the sow is exhausted by two or three days of labor and after the foetuses have begun to decompose.

EVERSION OF THE UTERUS AND VAGINA.

One of the accidents following parturition is the eversion or prolapsus of the vagina and the uterus. Only a portion of the uterus is involved, and it is seldom that a complete prolapsus of this organ occurs. This condition may occur before parturition.

The chief symptom of this accident is the presence of a tumor protruding from between the lips of the vulva, and which may hang some distance below that opening.

Treatment.—It consists in cleaning the organ with warm water and antiseptics and returning it to its proper position. If the part is badly swollen, take a strip of muslin about two yards long and two inches wide; begin winding from the outer end and wind toward the body and allow the bandage to remain on for ten or fifteen minutes. Keep the body end tight and remove the outer part and then rebind in the same manner. After removing the bandage, apply both thumbs to the center of the mass

and return it at once by a slow, steady pressure. The organ can be retained in position by placing a few stout stitches across the lips of the vulva.

INFLAMMATION OF THE UTERUS AND VAGINA.

Causes.—Inflammation of the uterus and vagina may be caused by injuries to the walls of the maternal passages and infection from pathogenic germs, or as a result of the retention of dead foetuses. This latter cause is not at all uncommon.

Symptoms.—These are tumefaction of the vulva, heat and redness of the mucous membrane lining the vagina, fever, straining, loss of appetite and dullness. In serious cases the temperature is high, the respirations quickened, and the animal shows evidence of severe pain. The inflammation may extend from the womb to the lining membrane of the abdomen. There may be a foul smelling discharge from the vagina. When the inflammation becomes chronic, as it often does, the appetite improves but the sow becomes very thin and weak, and the disagreeable discharge from the vagina continues. The prognosis is not favorable; the sow usually dies or is in such condition that it is not profitable to keep her.

Treatment.—Preventive treatment consists in being careful in manipulating the passages when aiding in parturition, and in preventing the infection of the parts by the proper use of antiseptics. The genital canal should be washed out twice daily with a two per cent. solution of creolin. A gallon or more of warm water should be used, and it is best to administer the douch with a fountain syringe. A cathartic can be given if necsesary. If depressed, alcoholic stimulants can be given. Quinine and salicylate of soda, twenty grains of each, and gentian, ten grains, should be given every four hours. This should be kept up until the fever has subsided and the appetite has returned. Nothing but slops should be fed. Tonics, good feed, and good care are very necessary in the chronic form of the disease.

SURGICAL DISEASES.

CHOKING.

Causes.—Choking may be due to sharp objects when swallowed penetrating the mucous membrane lining the pharynx or oesophagus, and at-

tempting to swallow objects (potatoes, roots, etc.) too large to pass down the canal. Paralysis of the oesophagus may sometimes cause it.

Symptoms.—If the choke is complete, the hog is unable to swallow food, salvia dribbles from the mouth and tympanitis may develop. If not relieved, death will occur from suffocation. The animal may get rid of the choke by vomiting. In partial choke there is difficulty in swallowing and salivation. In thin hogs if the object is lodged in the pharynx, it may be felt by pressing the pharynx with the fingers. If the foreign body is lodged in this region, instead of grunting, the hog will make a shrill sound.

Treatment.—When the foreign body is lodged in the pharynx, it may be pushed forward by pressing below it with the fingers, or a blunt flexible stick can be used in dislodging it. Mucilaginous drenches should be given, but drenches must be given carefully, as there is some danger of their getting into the air passages. Unless relieved soon after the accident has occurred, it is best to slaughter the animal.

HERNIA.

Rupture.

Causes.—Hernia is a condition in which a portion of the intestines or omentum have passed through the walls of the abdomen and lie just beneath the skin. Hernia in pigs is due to congenital defects, as an open umbilicus and a wide inguinal canal, and to increased pressure on the walls of the abdomen by the intestines caused by the pigs piling up and lying on each other, and to crawling through a small opening in the pen or fence. Congenital hernia makes its appearance soon after birth.

UMBILICAL HERNIA.

Symptoms.—Umbilical hernia is recognized by the presence of a swelling or tumor below the naval opening. The swelling is soft and free from inflammation, is larger at one time than at another, and by laying the pig on its back and pressing downwards on the swelling, it may disappear. Pigs with umbilical hernias do not thrive as they should and sometimes become stunted.

Treatment.—The treatment of umbilical hernia is not difficult, and is usually followed by good results. The method of operating is as follows. The pig is placed on its back and held there by an assistant, and with the finger the size and the position of the umbilical opening is determined. If the intestines do not pass back into the abdominal cavity of their own accord, they should be pressed back with the fingers. The hernial sack is then held by the assistant and a strong cord tied around its base close up to the abdominal wall. The ligature should be tied tight enough to cut off the circulation in the sack and cause it to slough off. The swelling caused by the ligature is sufficient to close the opening, and in a few weeks it will become obliterated. The simple ligature will answer for a small rupture, but if large, a multiple ligature must be used. The seat of the operation is first washed with an antiseptic wash. A slightly curved needle carrying a heavy linen thread that has been laying in an antiseptic solution is then passed through the base of the sack close up to the abdomen, the thread divided and each half tied separately, or one half can be tied and the needle carrying the other half again passed through and tied. The operation is repeated until the necessary stitches have been taken. In case of adhesions between the walls of the sack and its contents, the hernia cannot be reduced and it will be necessary to cut into the sack and break them down with the fingers, then close the opening by stitching across from muscle to muscle. Strict antiseptic precautions must be observed in performing this operation. The after treatment consists in keeping the pig by itself for a few days and in keeping the part clean.

SCROTAL OR INGUNAL HERNIA.

Symptoms.—This form of hernia occurs only in the male. The testicles lie toward the bottom of the bunch which may be so large that it drags on the ground. Raising the hindparts of the pig will cause the bunch to become smaller. Strangulation of the intestines seldom occurs. When the hernia is large, the pig does not thrive and will become stunted.

Treatment.—To relieve this condition it is necessary to castrate the animal. The pig should be starved the day before being operated on. The

covered operation is the one to be preferred. To remove the pressure from the scrotum, the pig can be hung up by the hind legs or held in this position by an assistant. The scrotum is then washed with an antiseptic wash and an incision made through its walls. The operator must be careful and not cut the covering (tunica vaginalis) of the testicles. The incision should be large enough to allow the testicle and its coverings to be drawn outside the scrotum, and permit the operator to break down with his fingers any adhesions present. A needle carrying a thread is then passed through the tunic and cord as high up as possible, the thread cut close to the needle and the cord and tunic ligated. The ligature should be drawn moderately tight and the cord and tunic cut off about half an inch above it. The ligature should be of strong material and when not in use, it should be kept in a vessel containing an antiseptic solution. The open operation, reducing the hernia, cutting through the coverings of the testicle, removing it and closing the opening the same as in umbilical hernia, can be used. It is best to keep the pig by itself for a few days following the operation.

VENTRAL HERNIA.

Scrotal and umbilical hernia are due to dilation of openings already present, all others caused by a tear or break in the abdominal wall, but not in the skin, are known as ventral herniae.

Causes.—Injuries are the cause of this form of hernia. Lying on one another in the pen, as is the case when they pile up, kicks and collisions with blunt objects are common causes.

Symptoms.—A favorite seat for ventral hernia in hogs is on the inside of the flank, the mass of intestines extending backwards between the hind legs. The size of the swelling varies and presents the same appearance as in other forms of rupture. If caused by a local injury, there is more or less inflammation in the part. This symptom is not noticed in old cases.

Treatment.—Treatment is not as satisfactory as in the other forms. After reducing the hernia an incision is made in the sack, and the opening in the walls of the abdomen closed by sutures the same as in umbilical hernia.

INFLAMMATION OF THE TESTICLES.

Causes.—Inflammation of the testicles in hogs is usually due to external violence, such as blows, kicks, bites from other animals, wound, etc. It may occur as a complication of some other disease.

Symptoms.—The first symptom noticed is a painful swelling of the testicles which may extend to the surrounding parts. The rapidity with which the swelling develops will depend on the acuteness of the inflammation. Sometimes the animal has a fever and abscesses may form. Hydrocele may occur as a complication of the inflammation.

Treatment.—A cathartic of castor oil should be given. Cold or hot water fomentations may be used to keep down the inflammation. Iodide of potassium can be given in the feed three times daily. If an abscess forms, it should be opened and washed out once a day with an antiseptic wash. In some cases it is necessary to castrate the animal. This latter operation must not be postponed too long.

HYDROCELE. HEMATOCELE.

Water in the Scrotum.

Causes.—This condition is due to injuries to the testicles and scrotum, the collection of fluid forming as a result of the inflammation of the covering of the testicles (tunica vaginalis).

Symptoms.—Owing to the large quantity of fluid (serum or blood) that may collect between the layers of the tunic, this condition may resemble a scrotal hernia. The swelling is soft, elastic, painless, and confined mostly to the lower part of the scrotum. The fluctuation of the fluid can be recognized on manipulating the swelling.

Treatment.—This is usually unnecessary, as it does not interfere with the health of the animal or endanger its life. The fluid can be drawn off with an aspirating syringe and tincture of iodine afterwards injected into the part. This operation must be performed under aseptic conditions and should not be attempted by the stockman. The fluid can be removed by castration.

INFLAMMATION OF THE PREPUCE.

Causes.—This disease is seen in barrows, and is caused by the secretions from the lining membrane of the prepuce and dirt accumulating in the prepuce or its side folds. If infected by germs, pus will form and the parts become badly inflamed.

Symptoms.—The prepuce becomes swollen, painful and hot, and there is some difficulty in urinating. Pressure upon the part causes the animal severe pain and a disagreeable smelling material may escape. The contents are usually of a cheesy character.

Treatment.—Before treating the animal, it is necessary to place it on its back, and hold it as quiet as possible. The outside of the prepuce should be fomented with warm water, and the inside of the pouch washed with a two per cent. water solution of any of the coal tar preparations. If it is not possible to remove the collection in this way, an incision should be made in both sides of the pouch. All the material must be removed and the part thoroughly washed.

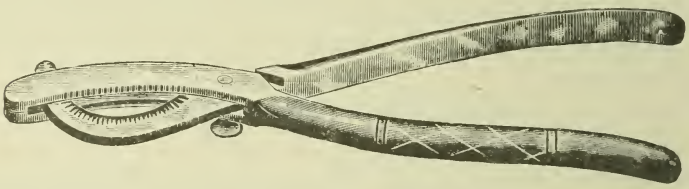
CASTRATION OF YOUNG PIGS.

The age at which castration in young pigs can best be performed is not fully agreed upon. It may be performed when the pig is a few weeks old and still nursing, or after it has been weaned, and when several months of age. Young pigs when nursing the mother do not suffer from the shock of the operation as much as at the time of weaning or when older, and the growth is not noticeably checked. Castration at all seasons of the year and under all sorts of conditions, is practiced, but where the conditions cannot be controlled after the operation, the most favorable seasons for operating are the spring and fall.

Sucking pigs need not be prepared for the operation. In older ones, it is best to starve them for about twelve hours before castrating them, and we should avoid getting the hogs warmed up, as will happen if we have to run them about in order to catch them. This can be avoided if the pigs are shut up in a small pen where the assistant can catch them quickly. One person will be able to confine the pigs for the operation. If the pig is small, the hind legs can be held with the hands and the

head and fore legs between the knees; or it can be laid on its side or back and the hind legs drawn well forward.

The operation is very simple. The operator should provide himself with plenty of antiseptic solution. It is best to wash the scrotum with a two per cent. solution of some coal tar product, and the knife, needles, ligature, etc., should be placed in a similar solution when not in use in order to prevent infection. The testicle is grasped between the thumb and fingers and pushed against the walls of the scrotum. An incision is made in the scrotum and tunic of the testicle parallel to the middle line or raphe, and from half an inch to an inch to one side. The incision should be made with one stroke of the knife and large enough to allow the testicle to slip out. In young pigs the cord of the testicle may be broken off and removed at one jerk. In older ones it can be severed by cutting and scraping with a dull knife. The opposite testicle is then removed in



The emasculator. The best instrument for castrating old and young.

a similar manner. Before liberating the pig, the incisions in the scrotum should be examined and if they do not extend to the very lowest part of the scrotum, they must be enlarged. This will allow the blood and pus to drain off instead of collecting in the part. The wound requires no after treatment. The pig should not be allowed to wallow in ponds or remain in dirty, dusty or muddy pens.

The operation in the boar with the excepting of severing the testicular cord is the same. The cord in old hogs is large and a dangerous hemorrhage may occur if cut off with a sharp knife. Scraping the cord in two with a dull knife, if properly performed, will so crush the blood vessels that little bleeding occurs. Another method sometimes used is ligating it before cutting it off. The best instrument to use is the emasculator. This instrument will so crush the ends of the blood vessels that no hemorrhage follows the operation.

COMPLICATIONS FOLLOWING CASTRATION.

This operation is not free from complications. Observations have proven that they are more common when the work is done carelessly, and no attention paid to antiseptic precautions, than if the proper care and antiseptic precautions are observed.

Hernia is a rare complication of castration, but may be caused by jerking the cord too hard when breaking it off, or from an injury to the pig while handling it. When operating we should be prepared to treat all cases of hernia, whether present at the time of the operation or resulting from it. The covered operation should be used for scrotal hernia.

Hemorrhage is not a dangerous complication in pigs. In old hogs it will occur if precautions are not taken against it. Excessive bleeding can be stopped by picking up the stump of the cord and ligating it. Packing the scrotum with clean cotton and suturing the incision in its walls, may stop it. The cotton should be left in the scrotum for at least a day.

Tumor formation in the scrotum is a common complication following castration. These tumors are sometimes enormous in proportion to the size of the pig and grow rapidly. If large, the pig does not thrive and becomes stunted. It differs from scrotal hernia and hydrocele in that it is very hard.

The causes are infection of the parts with germs, either at the time of operating or following it, and leaving the stump of the cord too long.

The treatment is to dissect the tumor out. This method of treatment will not be successful unless all the growth is removed. The operation is quite painful and frequently the pig dies as a result of it. If the tumor is small and the operation skilfully performed, the results are usually good.

CASTRATION OF CRIPTORCHIDS OR "ORIGINALS."

In "original" pigs the testicles fail to make their appearance by descending through the inguinal canal into the scrotum. Usually but one testicle fails to descend into the bag. It may be found in any part of the abdominal cavity, but in most cases is situated in the region of the flank.

The animal should be prepared for the operation by starving it for about twelve hours. The operator's hands must be clean and the antiseptic solutions and instruments gotten ready the same as in castrating a straight pig. The pig is laid on its side upon the floor or a board, the hind parts slightly elevated, and held there by an assistant. The operator stands at the back and clips the hair from the flank. An incision is made high up in the flank and midway between the point of the hip and the last rib, and large enough to introduce the fingers, or if necessary, the hand. When the testicle is found it is cut off with the emasculator, or the cord ligated and then cut. The incision in the walls of the abdomen is closed with sutures placed about an inch apart. The hog should be kept by itself and the stitches removed in eight or ten days.

SPAYING.

Spaying is performed for the same reason as castration, and, while it was practiced quite generally twenty years ago, it is seldom done now. The necessity for the operation has passed away. It is an operation that is profitable where sows are to be kept until a year or more of age. Under the present method of marketing at eight and nine months it is more profitable to permit the sows to advance to one or two months' pregnancy rather than spay and lose a short time in checked growth, and run the risk of a little loss.

When it is decided to spay, the pigs are prepared for the operation as for castration. They should be three months old and weight from thirty to sixty pounds. The pig is caught and held by two men, upon an inclined board, the head being lowest. The operator stands at the back and clips the hair from the flank over a space about two inches wide and three inches long. An incision is made about midway between the point of the hip and last rib and an inch below the points of the lumbar vetrebrae. The incision should be just sufficiently large to admit the finger. The forefinger of the left hand is introduced and follows the back. The ovaries will be found almost directly downward, suspended by a short ligament. They will feel like a raspberry or blackberry and can be mistaken for nothing else. If the ovary can not be found at once, pass the finger backward toward the bladder and search for the uterus (pig bed) and follow it forward to its termination at the ovary. Remove the ovary by tearing

it off with the the finger or cutting it off with dull scissors. The lower ovary may be removed through the same opening. Close the outside wound with two stitches, using silk thread or silk fishing line.

The operation may be performed through the middle line of the belly, the same as in spaying the bitch. The method is to hang the pig up by a gambrel with a loop for each hock, make the incision about two inches in front of the pubis and remove the ovaries as already indicated. This opening is closed by two sets of stitches, one in the deep muscles and a second in the skin. One of the objections to this method is the danger of small herniae.

In either method the part should be prepared by washing with carbolic acid and the hands and instruments should be clean. The loss from operating is slight.

PROLAPSE OF THE ANUS.

Causes.—Permanent protrusion of the mucous membrane lining the rectum through the anal opening is called prolapse of the anus. The cause is violent straining from constipation, diarrhea, or anything that will bring about a weakening of the spincter muscle of the anus. Sometimes it is seen among breeding sows, due to their eating cinders and pieces of wood, and the consequent constipated condition of the bowels.

Symptoms.—In some cases only a few folds of the mucous membrane appear behind the anus, in others forms a fair sized tumor rather hemispherical in shape, red and slightly painful. When exposed to the air for a time, it becomes swollen and darker in color, and finely become dry and the surface cracked. In time it will slough off.

Treatment.—Before replacing the prolapsed tissues, the mucous membrane should be bathed with warm water for a few minutes in order to reduce the inflammation and clean it. The protruded portion can be replaced by pressing on it with the finger. If caused by constipation a laxative of castor oil should be given and soft food fed the animal. Sometimes the prolapse will again occur and need to be replaced. If badly swollen, it is best to bathe it with an astringent solution (five per cent. alum solution). To retain it, a stitch can be taken across the anal opening. If the protruded part becomes injured or sloughs, it can be cut off and the margin of the bowel sewed to the margin of the anus.

INFECTIOUS AND CONTAGIOUS DISEASES.

HOG CHOLERA AND SWINE PLAGUE.

When and where hog cholera had its origin no one will ever be able to positively determine. It is not an old disease in the sense of having been known and described for a long time, like glanders or anthrax. Neither is it such a new disease as some would have us believe. The oft-repeated assertion of old farmers that twenty-five or thirty years ago the disease was unknown is merely evidence that the disease was not so generally distributed throughout the country. According to earlier investigations, outbreaks of disease occurred in Ohio in 1833, again in South Carolina in 1837, in Georgia in 1838, and in Alabama, Florida, Illinois and Indiana in 1840 that are believed to have been cholera. As close observations were not made or records kept upon stock diseases at that time, no doubt many outbreaks escaped unrecorded.

It is not known from whence the disease came; some writers claim that it was introduced into this country by the importation of hogs from England, while others hold that the germs are native to our soil and only need a favorable opportunity to produce the disease, the same as in black leg.

Hog cholera seems to have been introduced into this State from Ohio by the driving of hogs to the southeastern and southern counties for the purpose of fattening. At first the disease was confined to a narrow tract along the Ohio River, but the disease gradually spread northward and westward until it reached Terre Haute in 1847 and 1848. The first agricultural report, published in 1859 and 1860, contains a most interesting article upon this disease and dwells upon the heavy losses sustained in the southern part of the State. The history of the spread of this disease —following the lines of commerce—is strong evidence that it is not one indigenous to our soil. Every county has now been invaded and some of them very frequently, so that it may be said that we now have a general infection.

LOSSES.

The total loss to the swine industry in the United States has been variously estimated at from $10,000,000 to $25,000,000 annually, but there can be no doubt that in some years the loss greatly exceeds the latter figure. In 1896 it is probable that the loss was between $45,000,000 and $50,000,000. The annual losses vary between $1,250,000 and $5,000,000 in our own State.

According to the Bureau of Statistics the losses in the different years have been as follows:

Year.	Number.
1883	288,286
1884	351,156
1885	326,555
1886	402,164
1887	512,692
1888	326,359
1889	247,114
1890	256,991
1895	278,143
1896	580,267
1897	899,457
1898	372,868
1899	553,930
1901	236,870
1902	197,491
1903	295,672

The average loss for the sixteen years has been 415,076, having a value of more than $2,000,000. This loss will not be reduced to any appreciable degree in the near future. We know more about the cause of the disease, more about the disease itself, more about its relation to sanitary surroundings, but we do not know more about treatment nor much more about practical preventive measures than was known ten years ago. There is no doubt but that proper sanitary surroundings, pure food and water will do much to avert the losses, but these conditions will not be provided except by the few who appreciate the advantage of pre-

venting loss. Moreover, these diseases can not be wholly prevented by the best hygienic measures that can be provided, which tends to discourage those who do try, and makes others more negligent. Knowing about hog cholera is like knowing about the grip—it does not follow that we can control all the conditions that distribute the germs of disease.

TWO DISEASES.

Hog cholera and swine plague have been made the subjects or special investigation by the United States Bureau of Animal Industry and the greater part of our knowledge of these diseases comes through this source. There is also much credit due to numerous individuals who have studied these affections. Hog cholera has been known for a long time and is recognized as being identical with the disease called swine fever in England. Swine plague was not recognized until about 1890. These two diseases are the cause of practically all of our great losses among swine. In some outbreaks it is easy to distinguish which is present and in others the two affections may exist in the same herd.

There is a specific germ for each of these diseases. Hog cholera is caused by the germ or bacillus of hog cholera and swine plague by the germ or bacillus of swine plague. These germs differ in size, shape, activity, method of growth, resistance to external conditions, and in their effects upon the body. These differences are recognized by those working with the disease, but of course can not be seen without the special equipment found in laboratories. These differences may be briefly stated as follows:

The hog cholera bacillus is a small plant about 1-25,000 to 1-15,000 of an inch long.

The swine plague bacillus is only about one-half of this size.

The hog cholera bacillus is shaped like a short cylinder, rounded at each end, and has a number of delicate projections from the sides and ends like hairs.

The swine plague germ is oval and smooth.

The hog cholera germs have distinct movement.

The swine plague germs have no movement.

The hog cholera germs stain uniformily.

The swine plague germs will stain only at each end.

Hog cholera germs will live in the soil from two to three months.

Swine plague germs will live from four to six days.

Hog cholera germs will live in water from two to four months.

Swine plague germs live only from ten to fifteen days.

When hogs are fed upon cholera germs they will become diseased.

When hogs are fed upon swine plague germs they do not contract disease.

When hogs are inoculated with cholera germs the disease affects the intestines.

When hogs are inoculated with swine plague germs the lungs are affected.

There are other differences between these germs, but those enumerated should be sufficient to satisfy the general reader. The cause of hog cholera is always the bacillus of hog cholera and of swine plague the bacillus of swine plague, and no case of either of these diseases occurs without the germ being present. Other causes may produce diseases with similar symptoms and may thus be mistaken for these diseases. Other causes may so weaken the system as to make the animal easily susceptible to these diseases or external conditions may be favorable for the distribution of the germs. These are secondary causes, but are of great importance.

THE EFFECT OF THE GERMS UPON THE BODY.

Hog Cholera.—The germs of hog cholera are found in the blood and in the internal organs. They grow in bunches and as they are carried along in the blood stream to the small arteries and capillaries they act as little plugs to shut off the circulation in the part supplied by the little vessel. At each place the circulation is thus arrested we have a small red blotch, so frequently seen in the skin, meat, fat, and viscera of hogs that die of cholera. These blotches are so characteristic that meat inspectors have no difficulty in detecting cholera carcasses while hanging upon the gambrel. Another characteristic is that these blotches become redder the longer the time after death, while blotches from other causes become paler.

The spleen or milt, as it is commonly called, becomes enlarged, softened and filled with dark blood.

The intestine is the seat of more or less inflammatory change, particularly in the Peyerian patches and along the lymph tracts. The caecum is especially liable to these changes. In all cases in which the disease

Ulcers in the intestine, in cholera.

continues for some days there is ulceration. The ulcers may be small like a millet seed or be as large as a dime. They may be irregular, as in cases in which they follow the lymph spaces. The edge of the ulcer pro-

jects above the surrounding mucous membrane. The appearance of the surface may be yellowish, reddish, or brownish. The edges are not clean-cut, but are granular. The ulcer may be only in the mucous coat or in the mucous and muscular, but it is rarely perforating. Hemorrhages sometimes occur as a result of invading an artery or vein. The lymphatic glands along the intestine are always red and swollen and those in other parts are enlarged. The contents of the intestine are nearly always black and tarry and have a very foul odor. In some cases the hog will have eaten clay or other earth, causing very hard, dry faeces. The stomach is not often seriously affected. The lungs are either not affected or only secondarily. They usually collapse at death.

Swine Plague.—In swine plague the germs are more diffused through the circulation, but may cause the same red patches.The parts attacked are the lungs primarily, and other organs as complications. The effect in the lungs is to cause bronchitis and pneumonia. The mucous membrane becomes congested and thickened, blocking certain areas, and sepsis or pus formation occurs, making abscess cavities of greater or less size. These pneumonic areas may be small and numerous or a few and quite large. If the hog should die early in the disease the appearance will be that of pneumonia, but if late these abscesses will have formed and they will contain pus or cheesy material. The other organs are involved secondarily.

It will therefore be seen that hog cholera affects the intestines primarily and that the disease may extend to the lungs, and that swine plague begins with the respiratory organs and progresses toward the intestines. Both diseases may be present in the same subject and the lesions are not always typical and a diagnosis can not be made by the eye alone. This is recognized by the inspectors of the meat inspection service and now all cases are reported as hog cholera, while formerly they divided them.

THE LIFE OF THE GERMS OUTSIDE OF THE BODY.

The general behavior and effects of the germs inside of the body are fairly well known, but the history of the germ outside of the body still remains to be determined. The experiments which have been made with the hog cholera germ have not shown it to be able to live for more than

a few months in soil or water, and the results of the work with the swine plague germ have indicated that it can only live about half as long. The results of these experiments are at variance with the experience of any one who has had much field work to do. It is not an uncommon occurrence to have an outbreak of hog cholera follow the turning of hogs upon a field where others had sickened, died and been buried a year prior. Such a result often occurs after hogs have rooted out and eaten parts of carcasses that have been buried for a long time. The writer saw a typical outbreak of cholera follow the turning of hogs into an old house where others had sickened and died three years prior. After the first herd had died the doorways were blocked with rails and no stock had access to the place until three years later. The bedding had never been removed and in two weeks after use by the second herd, thirty out of thirty-six hogs were sick, and it was the only outbreak in that vicinity. People have related many cases similar to the above, the period sometimes being longer and at other times being shorter. Again we may note the turning of fresh hogs into a pen where dead hogs have just been removed and no disease follow. We can not explain all these apparently inconsistent cases upon the evidence from our experimental data.

The germs of some diseases, as glanders, can live for only a short time outside of the body, and hence can only be conveyed by close contact or by animals being placed in the stalls or pens where other cases of the disease have been. Such diseases can be stamped out by slaughter and rigid quarantine. Hog cholera and swine plague do not belong to that class of diseases. In other diseases of which anthrax is a type, the germs can live and multiply outside of the body for a long time and be able to produce the disease when a favorable opportunity arises. Anthrax has been known to occur as a result of eating the forage from the graves of former victims. There are observations which seem to show that the germs must have lived in the ground for at least seventeen years. The experiments with the hog cholera germs do not show them to possess the same resistive qualities attributed to anthrax, but there are many who do believe that they have a very similar life history in nature. If such be the case then the problem of how to control the malady becomes all the more difficult.

SIMILARITY TO TYPHOID IN THHE HUMAN SUBJECT.

Our present knowledge of the germ tends to show that in many respects its life history is like that of the typhoid fever germ. No one would claim that the diseases are identical or that typhoid is as virulent or contagious as hog cholera, but there are points of resemblance. The lesions in the intestines, lymphatic glands and spleen, in the two diseases, are so much alike that cholera is often called pig typhoid. When blood from a typhoid patient is placed in a culture of typhoid germs it causes them to cling together. When blood from a cholera hog is placed in a culture of cholera germs it causes a similar reaction. Typhoid germs are rarely ever found outside of the body and stools of a sick patient, but it is well established that most epidemics have their origin in the water supply. Epidemics of typhoid fever occur in cities, and no matter what may be the source of the water supply—river, lake or wells—it will be found that it is polluted with the discharges from people. Typhoid fever can always be arrested by securing pure water. The researches of the Indiana Experimental Station have demonstrated that cholera is also water borne. In a series of townships in this State it was found that from 33 to 200 per cent. more hogs were lost along the rivers and streams than at a distance from three to ten miles away from the stream. This could be attributed to the more general use of surface water. No such conclusion must be reached that the disease is only water borne, for we have seen the disease pass up the river as well as down and the pigs in a whole section of the country, from one to three miles wide, and from five to seven miles long, become affected simultaneously after a rain.

Less is known concerning the life history of the germs of swine plague than of those of hog cholera; its spread is less liable to be influenced by hygenic measures and it seems to be air borne. Germs very much like the swine plague bacillus have been found in the lungs of other animals. If upon further investigation they should be found to be the same, it will add to our knowledge of the nature of the affection and make us less ready to claim that the disease can be eradicated by sanitary measures.

THE WAYS BY WHICH THE GERMS ENTER THE BODY.

Experiments have been conducted to determine how the germs find their way into the body to cause disease. Hogs fed upon the carcasses of animals affected with cholera develop a virulent form of the disease in a short time. The intestines become the seat of typical lesions, while other parts are not seriously affected. If the germs be placed upon food or in drinking water, they will produce a like result. These experiments show that if the germs be ingested with the food or water, they will develop and produce the disease.

The germs have been sprayed in the air and the hogs made to inhale them. also injected into the windpipe, but the disease did not develop, which may be taken to indicate that in nature the disease germs do not find a point for development in the lungs, or at any rate not as a primary focus.

The germs have been inoculated beneath the skin, but it is only when very large numbers are used that disease occurs. This would seem to indicate that the hog does not contract the disease from inoculation as by the bite of the louse and injuries.

A similar line of experiments conducted with swine plague shows that it does not cause trouble when swallowed, but does do so easily when made to inhale air containing the germs or when germs are injected into the windpipe. The lungs are the primary seat of the affection, and thus differs from hog cholera. Inoculation experiments, both subcutaneous and intravenous, require such large numbers of germs that it would seem that natural inoculation by the louse bite could hardly prove fatal.

The conclusions from these experiments are that in nature, cholera is caused by the ingestion of the germs with the food or water, and swine plague by inhalation.

ACCESSORY CAUSES.

We consider all those factors which lower the resistance of the animal or which disseminate or propagate the germs as being accessory causes.

Among the causes which tend to lower resistance, we may consider feeding, shelter and breeding. The disease is often attributed to the

feeding of green corn, too much corn, etc. In 1896, the Iowa Weather Bureau published a map showing the distribution of the disease in the State. It was found that the greatest losses were sustained in those counties where corn constituted an almost exclusive diet. The lowest death rate was sustained in those countries in which dairying was an important industry and milk was largely used as feed. This was taken as confirmatory evidence of the bad influence of a corn diet. In 1897, the statistics showed that the losses were just the reverse from those in 1896; that the pigs fed upon corn suffered least. This disproved the conclusion of the previous year. As farmers feed in essentially the same way each year, it would be but rational to expect that the losses would be about the same if the feed was a causative factor. Neither is the sudden changing of feed a causative factor, as we have not yet had a single report of an outbreak of cholera at any experiment station as a result of a sudden and radical change of feed. The feeding of green corn or all corn can not be considered a wise health measure. When green corn is fed it should be with the same precautions as in the feeding of cattle—beginning gradually with old corn and increasing the quantity as the pig is able to stand it. This will avoid the diarrhea and intestinal irritation which prepares the way for the cholera germ. Any injudicious management in any kind of feeding will have the same effect. The hog needs a variety of food for strength and health and those best prepared to furnish it will probably fare best.

The hog needs some shelter; it need not be elaborate, something to break the scorching sun or beating storm, to have dry quarters in which to sleep and a clean floor from which to eat. The strawstack is the poorest shelter that can be provided, as it furnishes a place in which to pile up and be buried, overheated when lying down and makes a fit victim for cold. The hog does not need much bedding. A tight wooden floor upon which to feed is rapidly growing in favor from economical considerations, and will become equally as popular from the health standpoint when its value becomes better understood.

The breed of the hog makes no difference to the cholera germ. The objection often made by the farmer that pure-bred hogs are less resistive to disease is not well founded in fact. The razor-back, with digestive powers equal to any task that may be imposed upon them, will succumb

to the diseases the same as the finely bred Berkshire or Poland-China. No breed of hogs is immune to the disease, and the advice to cross our better bred swine with the southern hog is ill founded. All the advantage which they possess is in the fact that they are not so fat and all the vigor that will prevail against the disease can be obtained by using care in the handling of the improved breeds.

Among the agencies which may carry the germs are streams, wind. birds, dogs, people passing from one farm to another, buying hogs from infected herds, shipping hogs in unclean cars, exhibiting at fairs, etc. Some of these means are not within our control, but many of them are, and a proper understanding of them should lead us to prevent thousands of cases.

The germs of the disease may be carried from one place to another by birds of carrion. It is a common experience with farmers that hogs can not be raised upon a farm where there is a buzzard roost. I have learned of isolated outbreaks of the disease occurring from buzzards alighting to eat the carcass of a colt or other animal, and soon after the hogs gain access to the same place and contract the disease.

Dogs prowling about at night carry pieces of dead animals for a mile or more, across pasture fields, feed lots, leaving pieces here and there to be devoured by some unfortunate animal.

Men may carry the disease from place to place upon their boots, or particles of dirt remain upon the wagon wheel, and when dry, drop off in another lot. It should be a general rule never to allow agents for hog cholera cures to come near a pig lot where there are healthy hogs. They go about diseased hogs and do not use the precautions necessary to prevent the spread of infection.

Under some circumstances, I believe the wind may be the bearer of germs. If the germs be distributed along a public highway by the rendering wagon and become mixed with the dust it is possible and altogether probable that they may be blown on the pasture or on the feed lot and thus convey disease. I have seen a few outbreaks continue in one direction for several days after a constant prevailing wind from the southwest. The evidence in this case seemed to point to the wind as the distributing agent. In such cases the germs fall in the water or are taken in with the food.

WATER SUPPLY.

Undoubtedly a very important agency in the distribution of the disease are the streams and surface water supplies. This relationship was under investigation for a number of years. In 1895 the 60 townships bordering upon the Wabash, from Cass County to its mouth, show a loss of 150 head out of every 1,000 produced; 47 townships in the second tier removed from the river show a loss of 100 head per 1,000, or 50 per cent. more loss in the first tier than in the second tier. In 1896 the bordering townships lost 294 hogs per 1,000, the second tier 205 and the third tier 160. In other words, the loss was 34.4 per cent. more in the first tier than in the second tier, and 83.8 per cent. more than in the third tier.

In 1895, 44 townships bordering upon the north fork of the White River lost 138 hogs per 1,000, and 42 townships in the second tier 65 hogs per 1,000, or 112 per cent, greater loss in the townships bordering upon the river than in those a few miles removed. In 1896, the loss in the first tier was 231 per 1,000, in the second tier 156, and in the third tier 75, or 48 per cent. greater loss in the first than in the second, and 208 per cent. greater than in the third. In 1896, 44 townships bordering upon the south fork of the White River lost 200 hogs per 1,000; 58 townships in the second tier lost 150, and 42 townships in the third tier lost 109; thus making 33 per cent. more loss in the first than in the second, and 83 per cent. more loss than in the third. In 1897, the first tier of townships bordering upon the river lost 321 hogs per 1,000, the second tier 182, and the third tier 145; 76 per cent. greater loss in the first than in the second, and 121 per cent. more than in the third.

In every general epidemic of the disease of which I have record in this State the disease has spread from the rivers to the higher land. The evidence furnished by the large number of townships and for successive years should leave no doubt as to the important role which streams and surface water play in the spreading of this disease. If the larger streams are such important factors we can reason that the smaller streams have a like effect. Drs. Salmon and Smith made the following statement in their investigations of the disease. It is pertinent and should be remembered by all swine breeders: "Perhaps the most potent agents in the distribution of hog cholera are streams. They may become infected with the

specific germ when sick animals are permitted to go into them, or when dead animals or any part of them are thrown into water. They may even multiply when the water is contaminated with fecal discharges or other organic matter. Experiments in the laboratory have demonstrated that the hog cholera bacilli may remain alive in water four months. Making all due allowance for external influences and competition with the bacteria in natural water, we are forced to assume that they may live at least a month in streams. This would be long enough to infect every herd along its course."

It is a common practice throughout this State to give the hogs surface water in which to wallow and to drink. Small streams are dammed, drinking places are built into the rivers, a basin is scooped out to receive the water from a barnyard, open ditch, tile drain or spring. All of these afford the best conditions for introducing the germs into the herd. It is not uncommon to go along a public ditch or a stream during an epidemic and find the carcasses of hogs in every stage of decomposition, thus acting as the bearer of infection to new herds. The conditions are better now than ever before, but there are unscrupulous men who will take that means of disposing of their dead, and some one else must suffer.

Some springs afford pure water but many have only a surface origin and are no better than a tile drain. The worst feature connected with the use of a spring as a water supply is the fact that no provision is made for keeping the water clean and pure. The water usually collects in a pool and receives the surface drainage from all the land around and serves as a wallow. Under such circumstances it becomes little better than a pond.

In 1895, the station made an inquiry as to the source of the water supply used by the breeders of pure-bred swine. It was found that in nearly all instances in which they escaped disease, they used well water. Hogs receiving well water do become affected, but when we consider the numerous ways by which the infection can be carried, we are not at all surprised. A good well, however, must always be considered as furnishing the maximum protection.

A study was also made of the relation of rainfall to the disease. No relationship could be traced to the total rainfall for the year or to the total rainfall for any set of months. In general, a season with sufficient rainfall to keep a constant supply of fresh water in the streams or one

of sufficient drought so that the small streams, ponds, etc., become completely dry, are productive of least cholera. A year in which there is much stagnant water is productive of the greatest death rate.

The argument is advanced that the greater loss occurs along the rivers because more corn is raised, more hogs are fattened, and hence they are more crowded. In order to determine this point we divided the counties in the State into groups according to the number of hogs raised per square mile and determined the per cent. of loss for these groups. This is presented in the following tables:

1883-1890.

Number of Hogs Per Square Mile	Number of Counties.	Per cent. of Loss
1- 24	1	8.1
25- 49	7	4.5
50- 74	20	5.9
75- 99	12	9.1
100-124	16	8.3
125-149	11	7.9
150-174	7	8.1
175-199	10	8.8
200-224	8	10.

1895-1897.

1- 24	2	7.7
25- 49	22	9.1
50- 74	18	11.1
75- 99	16	17.9
100-124	12	19.2
125-149	8	17.3
150-174	7	21.6
175-199	4	22.2
200-224	3	26.

During a period of eight years there is comparatively little difference in the losses, but during the period of three years when the disease raged with unusual violence the percentage was much higher in the counties

having a large number of hogs per square mile. It is not possible to tell how much of this increase in loss is due to the greater number of hogs, as it so happens that the counties having a very large number of hogs per square mile and large percentage of loss also have one or more rivers passing through them. From a comparison of counties about equally situated but the number of hogs per square mile very different, I am of the opinion that the number raised is not a very important factor in determining the per cent. of loss.

The season of the year when cholera is most prevalent is always in the late summer and fall. It occurs at all times of the year, but like all the intestinal diseases, as dysentery, typhoid fever, etc., in people, the conditions are more favorable for germ development in the fall.

Hog cholera is often contracted as a result of buying hogs from stockyards for feeding purposes. This is such a common experience that only the strong-headed or uninitiated will be likely to take the risk. The large stockyards and the majority of shipping cars are permanently infected with disease and no matter how healthy the hogs may have been when they started from home, they come in contact with infection and should never be withdrawn from the yards for feeding purposes. We have recorded many outbreaks caused in this way. It has been claimed that the shipping of diseased hogs over the railroad may be the means of causing new outbreaks of disease. I made this a particular object of research in 1895 and 1896, but in no case have I been able to find more cholera along railroad lines than at a distance of a mile or two upon either side. Under the present method of having the right of way fenced, I feel certain that the infection from this source is over-rated.

It would be useless to try to go into detail concerning all the methods by which the disease is distributed. Any means by which the germs are carried from one place to another can be considered an accessory cause. Alll of these means are not under our control, but many are and we will succeed in prevention in the same measure as we eliminate them.

SYMPTOMS.

The diagnosis of the different swine diseases is attended with greater difficulties than the diagnosing of diseases in horses or cattle. Except

upon very careful examination the general symptoms of swine diseases seem to be very much the same. Cholera assumes several different forms and therefore can not be recognized by any specific set of symptoms.

The symptoms vary greatly with the virulence of the outbreak. It may be said to assume an acute form which may run a course in from a few hours to two or five days, a subacute form which runs its course in from five to ten days, and a chronic form which may last a month and more. These are only relative terms and merely used for convenience in describing the disease. The symptoms as here described are for the more common cases that live from five to ten days. About the first symptom to be observed is a general sluggish condition, the eyes more or less closed and dimmed, the ears drop more than usual, and although the hog eats, it is not with that greediness that is customary. The appetite becomes depraved and he will eat the droppings from other hogs or chickens, eat clay and earthy substances. The hog lies about more than usual, hiding in fence corners, under litter, and in out of the way places. During the hottest days he will prefer to lie in the scorching sun rather than in the shade. At first he will respond to calling for feed but later he will not get up unless urged to do so. During the progress of the disease and sometimes from the very beginning there will be pronounced rheumatic symptoms. The hog will be lame first in one leg and then in another. The back will be arched. Diarrhea usually makes its appearance with the onset and is almost always present at some time during the course. The discharges at first are thinner than normal, but they rapidly become tarry and have a characteristic offensive odor. Constipation may occur and is almost sure to do so in those animals that eat earth. In some of the animals the intestinal contents make casts that perfectly occlude the passage and when struck with a board give the sensation of baked clay. Vomiting is also present. There is rapid emaciation. The fever is high and the breathing rapid but not labored.

In the very acute cases, the toxins cause such rapid poisoning of the system that death is so sudden that the symptoms may not be developed. A pig that will be eating at the trough at one hour may be dead the next.

In the chronic type especially, there is likely to be swelling of the ears and cracking of the tail. Both may drop off. The eruption is more pronounced upon the skin. Ulcers may form from the size of a grain

of wheat to the size of the hand. The hair is lost. There is frequently hemorrhage from the nose and sometimes sore mouth and feet. There is coughing as a result of lung involvement.

In hog cholera the great fatality is among the pigs, the older hogs often making a recovery or not being attacked.

In swine plague a cough is probably the first symptom observed. It is paroxysmal at first but is deep seated. This is more noticeable when the animal first gets up or after exercise. Later the cough is more persistent. The breathing is short and rapid with little movement to the ribs and a double jerk in the flanks, like a horse with heaves. The breathing becomes more labored, the throat swells and there is nose bleed. If the hands are pressed over the ribs there will be evidence of pain, often due to pleurisy. The animal will not move more than necessary, the appetite remains better than in cholera, there is much thirst and much less tendency to diarrhea. Constipation is more frequently present than in cholera. The eyes are more inflamed and watery and there is less tendency to skin eruption. Swine plague is particularly liable to attack and be fatal to old hogs. Both diseases may be present in the same herd and even in the same animal at one time, thus complicating the symptoms. In nearly all cases where there is doubt and a number of hogs are similarly affected in the same neighborhood, it is safe to conclude that one or both of these diseases are present.

Hog cholera is sometimes mistaken for other diseases, as worms, diarrhea, or scours, septicemia or blood poisoning, etc. Swine plague is frequently mistaken for pneumonia, pleurisy and bronchitis.

In some places the intestinal worms become so numerous as to cause all the intestinal symptoms ascribed to cholera, vomiting, diarrhea, depraved appetite and emaciation. The onset of the trouble is not so sudden; there is not the same temperature, usually no lameness, and no skin eruption. The worms causing the trouble may be the large intestinal worms, the size of a lead pencil or larger, or the small fellows from one-half to three inches in length. A post-mortem will show the presence of the parasites in great numbers and the intestines will be more or less irritated. The presence of the parasites causes so much loss that some of the cholera cures are nothing but vermifuge powders. The lung worm may also produce symptoms that will be mistaken for swine plague.

Diarrhea, or scours, may also be mistaken for cholera as it is so often induced by a change of feed as turning upon new corn, feeding city slops that contains soap and sour feed. The discharges are usually more fluid and of lighter color than in cholera. The diseases can not be distinguished in the early stages, but a change to a limited dry diet will usually be all that is necessary to bring about the desired result in the diarrheal trouble.

A form of septicemia, or blood poisoning, sometimes attacks a bunch of pigs and being contagious, spreads from one to another. The mouth, nose, lips, tongue, feet or other parts of the body become gangrenous While the disease presents some of the symptoms of cholera, the localization of the trouble is sufficient to make a diagnosis.

Hogs will pile up in bunches when not properly divided and protected during the cold weather, and as a result catch more or less severe colds, resulting in bronchitis, pneumonia and pleurisy, giving rise to symptoms like those of swine plague. The same troubles may also appear as a result of turning hogs upon a stubble or pasture field during very hot weather and then permitting them to have access to cold springs or brooks in which to wallow. These same troubles sometimes arise from the inhalation of dust. A study of the conditions will usually suffice to differentiate the troubles.

TREATMENT.

The treatment naturally divides itself into medicinal, hygenic and preventive. The medicinal is the least important, as we have no specific for the disease. Veterinarians who have made a careful study of the action of drugs and of the character of the disease have tried everything that would seem to be a rational treatment, but have failed. Pathologists have recognized the apparently hopeless condition to be treated and have been unable to suggest a remedy. Experimenters have tried everything which science and empiricism has claimed would cure, but they have found nothing which they could endorse. Notwithstanding all the futile efforts that have been made by careful and conscientious workers, backed by large sums of money and every facility for investigation, we have more than one hundred sure-cure cholera remedies upon

the market in this State. According to the manufacturers (and the claims are all alike), the prevention and cure of hog cholera is a very simple thing and depends wholly upon whether the farmer is willing to buy a few packages of their remedy and use as directed. It is impossible to make a close estimate of the amount paid for such preparations, but it is safe to say that in this State it amounts to more than $100,000 annually.

In 1897 and 1898 the writer devoted considerable time to the investigation of the merits of the various preparations upon the market. Many of these preparations are the product of misguided men, wholly ignorant of the pathology of the disease and equally as ignorant of the action of the ingredients in their concoctions. From a very limited trial they had drawn conclusions and sincerely believed they had discovered a sure cure and were willing to part with it for a large compensation.

A much larger number of the remedies are prepared by men and companies who know the value of a well-worded advertisement and who are in the business for revenue only. They take the formula published by the Bureau of Animal Industry, alter it in some slight particulars, call it by another name and increase the price probably ten times. Another favorite scheme is to take the formula of some of the patented preparations and sell the remedy under a new name, well knowing that if it failed under one name that it would act no better under a new. I was informed that Brown County clay sold for seventy cents per pound.

A third class of remedies are prepared by men who make a study of the disease. They constitute a very small minority.

There is no better evidence that we have no sure remedy than the fact that we have so many upon the market. In these experiments one hundred and fifty-six remedies were tried and nearly 4,200 pounds of drugs. All the formulae given in the patent office reports were filled. A large number of formulae were obtained from the owners and manufacturers, a few by analysis and several hundred pounds of the proprietary remedies were used.

The plan was to test each remedy upon at least five herds in as many places and at different times during the season, in order to work over all the conditions. Without going into details, it may be said that none of them fulfilled their claims. Some were positively injurious. Many of them seemingly did good upon some herds, and if a hurried conclusion

had been reached, it would have been favorable. This is an error too often made and no test can be considered satisfactory that is not used upon a large number of hogs in different herds, in different localities and at different times during the season. The good effects often reported are frequently due to the better care and better hygienic conditions in following the directions. Some manufacturers accompany their goods with carefully compiled directions upon care and management, and as they cost considerable, it insures their being carried out. It must be confessed, however, that directions come high at fifty cents per pound.

Very few remedies find a place upon the market for more than five years. The great majority of them run their course in two years, and the writer is cognizant of but three that have been sold for a period of more than ten years. This is the test of their efficiency. In every instance in which an attempt has been made to take infected hogs from the stockyards, treat them and fatten them for the market, the result has been a failure.

In 1897, Mr. John Cowie, of Iowa, tested a number of the more widely advertised remedies and the results were unfavorable. Dr. Reynolds, State Veterinarian for Minnesota, after examining the matter carefully, issued a circular advising the farmers not to purchase the remedies.

In mild outbreaks and in very many cases much good can be accomplished by such remedies as will keep the bowels clear and act as an alterative and tonic. For this purpose we have a prescription generally known as the government formula, and is as follows:

Wood charcoal, 1 pound.
Sulphur, 2 pounds.
Sodium chloride (salt), 2 pounds.
Sodium bicarbonate (baking soda,) 2 pounds.
Sodium hyposulphite, 2 pounds.
Sodium sulphate (Glauber salts), 1 pound.
Antimony sulphide, 1 pound.

The dose is a tablespoonful for each 200 pounds once or twice a day. It is best given in slop. This costs about ten cents per pound and is the one so much imitated and sold under different names at from twenty to fifty cents per pound.

Our best results in the treatment of mild cases were obtained by using the following:

Chlorate of potash, 1 pound.
Bicarbonate of soda, 1 pound.
Nitrate of potash, 2 pounds.

The dose is the same as in the former prescription. In the early stages and when constipation is present, five grains of calomel are admintered once a day to each 200 pounds of weight, or oil meal is added to the slop.

Another treatment which found considerable favor was a tablespoonful of a saturated solution of chlorate of potash and a like quantity of tincture of muriate of iron once or twice a day for each 300 pounds.

A half gallon of kerosene to a barrel of slop mixed thoroughly gave better results than three-fourths of the remedies tried.

Quinine and salol were also of service.

Carbolic acid and like preparations are disinfectants and not cures.

The treatment of inoculating worn-out horses with cholera germs, killing the horse and feeding it to the hogs was not a success. The feeding of the carcasses of hogs that had died of the disease and then buried is to be condemned. The boiling of the carcasses of cholera hogs and feeding them has likewise disappointed those who have tried it. A final method of prying open the hog's mouth and cutting off the papillae inside of the jaw only abstracts blood.

Recently it has been found that sulphate of copper in very dilute solutions is effective in sterilizing contaminated water. Acting upon this basis, experiments have been made using one to two ounces of copper sulphate to the barrel of water. The results have been above the average to date. The time has been too short to promise anything definite.

PREVENTION BY VACCINATION.

The attempt to prevent hog cholera by vaccination is dependent upon the fact that one attack confers immunity against subsequent attacks. Vaccination has been used against smallpox in the human subject with the most marked success. In this case the pox germ is obtained from the

cow and when vaccination takes place it induces a very mild disease. Vaccination is also used against anthrax in sheep and cattle Here the disease germs have had their vitality reduced by artificial means and only a mild attack follows. The results are highly satisfactory and sheep and cattle are now raised where it was impossible to do so before.

The attempts to vaccinate against cholera have not been successful. In the first place, we know of no animal having a similar disease, the germs of which when inoculated into the hog will confer immunity, and no method of attenuating the germs so that they can be inoculated with safety has yet been discovered. Some years ago Billings and Detmers each thought they had discovered successful means of vaccination and the work was carried on on a large scale. The results were unsatisfactory and had to be given up, as it had the effect at times of starting the disease where it did not previously exist. The work was revived at the Kansas Experiment Station but without great success.

THE ANTI-HOGCHOLERA SERUM.

The serum treatment of hog cholera was probably first demonstrated by Dr. Peters in 1896, and the same work undertaken at almost the same time by the Bureau of Animal Industry. The serum treatment is based upon the same principles as are involved in the anti-toxin for diphtheria.

It is a well established fact that in some bacterial diseases a strong resistance to the growth of bacteria is developed by the formation in the blood of a substance known as anti-toxin. The germs form a toxin or poison and the body forms the anti-toxin to counteract the growth of the germs. If the formation of the anti-toxin is in excess the patient recovers, and it has been found that blood from such a patient can be drawn, the anti-toxin separated, and if added to the blood of a patient that is exposed or affected it will prevent the disease or bring about a recovery. In order to secure anti-toxin in medicinal quantities, it is usual to inoculate animals that do not have the particular disease and produce a slight attack, and after recovery, reinoculate and repeat until the animal can stand an enormous quantity at one time. A quantity of blood is drawn and the serum separated and this is ready for use.

The government has experimented upon a large scale with this treat-

ment and in the main the reports have been very favorable. A number of private firms have attempted the same thing, but up to the present they have not been very successful. This treatment does not promise nearly so much, in the estimation of the writer, as the public has been led to suppose. The serum can not be produced at low cost and its administration requires the service of a veterinarian, two conditions which militate against its general usage.

PREVENTION.

As we have no specific for the disease nor any line of medication that is fairly successful, we must rely upon prevention. This can not be done to the same extent as in many other diseases, and this is especially true of swine plague. To enumerate all of the steps would necessitate repetition of points already made, so that only the more prominent will be considered.

First, the water supply should be from deep tubular wells. Water from a tubular well must come in from the bottom, which means that it has been filtered through the soil and the possibilities of pathogenic organisms being present is reduced to the minimum. Treat all surface water, whether pond, creek, spring or river, as unfit for man or beast. The feed should be pure and wholesome. Slops that have stood and fermented are not better suited to the stomach of the hog than that of some other animal. The dishwater contains so little nutrition that it would be more economical to throw it away than to feed it. Corn is undoubtedly our cheapest fattening food, but should not be given alone to sows and pigs. The addition of a little oil meal or other material rich in protein will be most advantageous. Pasture should be used in season. Hogs are fond of charcoal, ashes and salt, and these seem to furnish something to the body that is decidedly beneficial. The cobs from the feed floor should be raked into a shallow pit and burned to a char and salt added at least once a week. Nearly all prominent breeders follow the practice of supplying charcoal, salt and ashes in some form and many attribute to it the power of preventing disease. A feeding floor should be provided. The bedding for hogs should be like that for other stock—a little at a time and removed often. There is no better reason for com-

pelling a fine sow to lie in her own filth than there would be in the case of a good horse. The bedding of both will become foul and should be removed. It can not be kept pure by disinfectants. Hogs should have no bedding during the warm season, only a dry place in which to sleep.

In case of an outbreak of disease upon the premises, separate the well hogs from the sick and confine all in small lots upon one part of the farm. Separate the well hogs from the sick, as the contagion is spread by the droppings and excreta and the well hogs would be subject to the contagion if kept upon the ground where the sick had been. Formerly the recommendation was made to give the hogs the benefit of a large pasture and keep constantly dividing the herd. Experience has shown that this has the disadvantage of getting the germs scattered all over the farm, prolonging the outbreak, and has no advantage over placing them in two or three small lots. By the latter method the business of hog-raising can again be started as soon as the outbreak is over, using some other part of the farm. Use plenty of disinfectants about the place. Air slaked lime, whitewash, chloride of lime, carbolic acid, etc., are all good. If possible have one man to feed the diseased and another to feed the well hogs. Take advantage of all the sunlight that it is possible to get, as that is the cheapest disinfector.

No rule can be laid down for guidance as to the time when pens, etc., may be used after an outbreak of disease. We have observed instances in which this was done immediately and disease did not follow, and in other cases weeks and months have elapsed and a fresh outbreak would be started. If the place is thoroughly cleaned and disinfected and is well lighted a few weeks will be sufficient, but when it is feasible it is better not to attempt it again during the same season. Experience has shown that a wise precaution is not to permit the hogs to graze or be in pens alongside a public highway. Hogs having the disease and driven to market will leave droppings that become mixed with dust and blown upon the premises. It is the observation of the writer that this is a precaution not sufficiently emphasized.

Hogs may be disposed of in two ways, by burial and burning. If by burial it should be well done, upon a dry place at least three feet deep and in a woods or field to which hogs will not have access for a long time. If it be true than the disease germs live for a long time in the soil then

burial only favors the development of some subsequent and unexplained outbreak. Where burial is practiced, the addition of a quantity of quicklime will be effectual in destroying the germs.

Burning is not difficult when properly done. The essential point is to get at least a foot of wood under the carcass. A very much smaller amount of wood will be required where the fire is under rather than at the side. All carcasses should be disposed of at once and it is far more economical to kill badly infected hogs than to have them linger around for a week or two.

STATE CONTROL.

The argument is often made that the state should exercise some control over hog cholera and swine plague. The precedent is cited that the government stamped out pleuro-pneumonia in cattle and has saved millions of dollars to the cattle interests. The different states take cognizance of glanders and practically have that malady under control. Southern cattle fever is now confined to restricted areas, and sheep are being dipped for scab. The diseases which have been stamped out or brought under control have been of such character as to require close contact to spread them. Hog cholera is a disease of different character and therefore is not amenable to the same methods. Typhoid fever in people sometimes assumes an epidemic character in cities, but by condemning wells and compelling the use of wholesome water the disease can be stamped out. Hog cholera is a water-borne disease and can be prevented in part by securing pure water, but there are other means of spreading the infection. We have little to guide us in what may be accomplished by state control. England has tried to stamp out the disease by preventing the shipment of pigs unless inspected, no hogs to be shipped from a swine fever district, and none to be moved within sixty days from the time of an outbreak. In the shipment of pigs all cars must be disinfected and it becomes the duty of the owner to report every case of the disease as soon as it appears and the animal is slaughtered.

Prior to 1896, the regulations were not so rigid and the effect of the attempt at control may be seen from the following table:

Year.	Outbreaks.	Hogs Slaughtered.
1894	5,682	56,296
1895	6,305	69,931
1896	5,166	79,286
1897	2,155	40,764
1898	2,514	43,756
1899	2,243	30,386
1900	1,940	
1901	3,140	
1902	1,688	
1903	1,478	

The effect has been to greatly reduce the number of outbreaks and also the number of animals slaughtered. For a time the reduction in the number of outbreaks and also of pigs slaughtered was so marked that much hope was entertained that it might be possible to completely control the disease. The very serious restriction to trade and the heavy expense has brought many protests from the producers. The recent report of the government veterinarian admits disappointment in not being able to stamp out the trouble.

In 1897 the government undertook an experiment in Page County, Iowa, to determine what might be accomplished by county police measures. The plan was to canvass a part of the county and determine the number of pigs raised the year before, the number that died and the number now on hand. Upon receipt of notice of an outbreak the veterinarian called and killed all the sick and paid the owner at market rates. Disinfection and general cleaning of the premises followed. It is believed by some that the saving more than paid the expenses.

Several of the States have laws upon hog cholera, but they usually define the manner in which the carcass shall be disposed of. Minnesota probably undertakes more than any other State and there the matter is in the hands of the State Board of Health. Canada demands a certificate of a clean bill of health from the State Veterinarian before they can be shipped in. The tendency is toward making transportation companies disinfect cars, yards, etc.

In our own state, the law requires burning or burial of the carcass;

it requires a statement of health to exhibit at the fairs and the disinfection of pens, etc., at fairs. It is an imperfect law but has been the means of saving many thousands of dollars.

DISEASE SIMILAR TO HOG CHOLERA.

Recently the Bureau of Animal Industry has described a disease that can not be distinguished from hog cholera but which is not due to the hog cholera germ.

Cause.—The germ causing the disease has not been described. The time between exposure and development of disease is from seven to twelve days. The hog looses appetite, is listless and by the second day appears sick. The flanks become hollow and the appearance gaunt and the gait becomes staggering. Dirrhoea may or may not develop. The symptoms gradually become worse and death occurs about the seventh day.

Appearance.—The skin is red or blotched and these are made up of numerous small spots. The lymphatic glands are enlarged and red. The stomach and small intestines appears normal or to have small red spots. The large intestines are covered with reddish spots and these run together near the rectum to make the appearance of a solid reddened area. The kidneys and lungs show the same reddened areas. The liver is mottled with gray. The spleen is enlarged.

Treatment.—None is recommended as too little is known concerning the diseaese.

ULCERATIVE STOMATITIS.

Infectious Sore Mouth in Pigs.

Causes.—This disease is common in pigs from a few days to several weeks of age and is infectious in character. No specific germ, however, has been found. Dusty, dirty or muddy quarters are among the predisposing causes. Under such conditions the sow's udder is exposed to dust and dirt and acts as a carrier of disease producing germs. The disease may be spread by diseased pigs infecting the teats of the mothers of healthy litters.

Symptoms.—The mucous membrane lining the lips and cheeks is

swollen and inflamed. This is frequently quite marked, the snout and lips becoming so badly swollen that the pig can hardly breathe. In the beginning the pig is careless of the teat and as the ulceration progresses, it becomes unable to suckle. The ulcers form quite readily on the lips, snout and tongue, appearing as light colored spots elevated above the healthy tissue. These soon break down and slough off, leaving deep cavernous excavations that may involve several of the teeth, or a large portion of the lips or snout. In extreme cases the end of the lower jaw or the whole snout may drop off. The ulcers on the face and body appear as brown scabs that soon open into deep pits or cracks. The pig acts very dull, is feverish and being unable to suckle, becomes greatly emaciated and soon starves to death. In advanced cases treatment does but little good. If recovery does occur, the pig is usually stunted, or deformed about the face or lips. The disease may end fatally in from three to ten days.

Treatment.—The preventive treatment is very important. The diseased pigs should be isolated from the healthy ones, the pens kept clean and disinfectants used freely. The diseased pigs should be dipped head foremost into a two per cent. watery solution of any of the coal tar disinfectants, or the mouth dipped into a solution of permanganate of potassium, (one ounce to the gallon of water). This must be repeated once a day for several days. It is also best to wash the udder of the mother with a similar solution. When the ulceration is well advanced, the dead tissue should be removed and lunar caustic rubbed on the parts. It is usually economy to destroy the badly diseased pigs.

TUBERCULOSIS OF HOGS.

The abattoir statistics published by the Bureau of Animal Industry show this to be a fairly common disease of swine. Tuberculosis has been increasing among hogs during recent years, but is not nearly as prevalent here as it is in European countries. There the disease is also more prevalent among cattle, and statistics show that the percentage of tubercular hogs increase as the affection becomes more common in cattle. The disease is more often seen in young than in old hogs, and is generally acute and generalized.

Causes.—The specific cause of tuberculosis is the bacillus tuberculosis, which was discovered by Koch in 1882, and can be found in the nodules and tubercules in the tissues of diseased hogs. These bacteria usually occur in the form of slender rods averaging from 2μ to 5μ, in length and nave rounded ends. They may be seen singly, in pairs, and in small bundles, and do not form spores, but vacuoles. There is probably no disease producing germ which undergoes greater modifications under various conditions for environment than this one. Pigs generally contract the disease by eating infected food; skim milk, butter-milk and slops from the dairy. Young pigs may become diseased from sucking a tuberculous mother. The eating of tubercular carcasses may also cause it. Infection may take place through the inspired air, and when tubercular hogs are introduced into a herd, all the hogs in the pen may contract the disease.

Predisposing conditions are very important factors, and such conditions as act unfavorably on the constitutions of the pig, will, if the germs are present, favor the development of the disease. Close pens, filth, unnatural bringing up, early forcing, etc., all favor its development. Improved breeds of swine are said to be more predisposed to the disease than the common breeds. Infection has been known to occur by way of wounds, specially castration.

Symptoms.—These will vary according to the organ affected. In pigs the disease is often acute and generalized. Generally the symptoms are not well manifested, or the infection may be slight and the disease is not recognized by the owner unless a post mortem examination is made on some of the dead animals. In young pigs that have become infected by sucking a diseased mother, sympotms of intestinal tuberculosis may be manifested. The pig becomes runted, "pot-bellied" and emaciated. The visible mucous membranes are pale and the skin presents an unthrifty appearance, and may become covered with crusts. Digestive disorders occur, such as diarrhoea, bloating and vomiting. Manipulating the abdomen may cause the animal pain and sometimes a hard knotty mass, representing a bunch of tubercles, is felt. The pig is feverish at times.

If the lungs are involved there is a cough. This becomes more annoying as the disease progresses, sometimes the pig almost chokes. The breathing is quickened and labored. Frequently the superficial lymph glands in the region of the pharynx are affected.

In tuberculosis of the brain, nervous disturbances are noted, such as turning round and round, convulsions, spasms of muscles and paralysis. Only part of the body or certain groups of muscles are involved. The head may be held obliquely, the snout drawn to one side and the ears droop.

The course of generalized tuberculosis is short in young pigs, but may last for months in older ones. When localized, it is recognized only after the animal is slaughtered.

Lesions.—The changes in the tissues following the invasion of the baccillus tuberculosis are the formation of nodules or tubercules, gray or yellowish white in color, or translucent in character. In some cases those nodules are distinct and easily recognized, but in advanced cases they often come together and form a mass of tubercular tissue.

In the beginning the tubercle consists of a few cells surrounding the invading germs. These are soon enclosed in a zone of epitheloid and giant cells, which in turn become surrounded by a layer of lymphoid cells. The central portion of the tubercle soon dies and breaks down, and as the nodule enlarges, the necrotic portion gradually increases. When cut, the nodules or masses of tissue are usually made up largely of yellow caseous material. Sometimes it is indurated and almost as hard as cartilage. Calcareous degeneration of nodules is not often seen in hogs.

As the disease is nearly always contracted by the ingestion of infected food, the digestive apparatus and lymphatic glands are usually involved. Localized lesions in the lymphatic glands (pharyngeal and submaxillary) are very common. They become enlarged, knotty and hard. When cut open, they are made up mostly of old fibrous tissue with yellow caseous centers scattered through it. Ulcers and milliary modules may be seen in the intestines; yellow milliary granules may be scattered throughout the liver tissue, or tough nodules, yellowish white in color and varying in size from that of a pea to a hazel nut, may be seen; the peritoneum is sometimes the seat of fine granulations; and lesions the same as exist in the liver may be seen in other internal organs (spleen, lungs, etc.). When the disease is generalized, the muscles are sometimes affected.

Treatment.—We must take all precautions possible against infecting the herd by avoiding the feeding of infected food, and by keeping the hog houses and pens in the best hygenic condition possible. Hogs should not

be fed skim milk and slops from a dairy known to have tuberculosis, and it is a very bad practice to feed hogs the carcasses of other animals. When a hog has tuberculosis, it should be destroyed and the body disposed of in a suitable manner.

INFECTIOUS CATARRHAL PNEUMONIA OF THE PIG.

Causes.—There is a form of catarrhal pneumonia of pigs that is without doubt of infectious character. The infectious nature is established from the clinical history rather than from the finding of a specific organism. It affects pigs under four months of age principally, and is not attended with a very high death rate in those over two months of age.

When the disease is introduced into a piggery, it is almost certain to attack all susceptible animals. The period of incubation, that is the time elapsing from the period of exposure to that of the development of the illness is from ten to fifteen days. The young pigs become affected first, while a large percentage of those over four months will escape.

Symptoms.—The first and most prominent symptom is that of coughing and this persists throughout the entire course of the affection. There is also more or less difficulty in breathing. The cough at first is weak but soon becomes loud and is attended with considerable effort. It comes on in paroxysms and then there is a longer or shorter interval of quietude. The coughing spells are almost certain to occur when the pigs first stir about and when they take their meals. If the quarters are clean and the weather pleasant, the coughing is about the only symptom observable. The appetite remains good and the fever is not high. If the weather becomes cold, wet or stormy, the paroxysms of coughing come closer together, sometimes amounting to almost continuous coughing. There will be marked difficulty in breathing, loss of appetite and fever. The other symptoms of illness are rough coat, stiffness, and weakness. Under such conditions there will be a considerable loss of the weaker pigs in the litter and especially of those under eight weeks of age.

The disease may be confused with swine plague or hog cholera. It can be differentiated from the plague from the fact that the latter disease attacks older hogs and the death rate is highest in old hogs. It can be distinguished from cholera by the fact that there is little bowel disturbance and much lower death rate.

Post mortem.—A post mortem examination reveals clearly defined red patches spread over the lungs. They are most numerous along the edges, particularly along the lower edge of the anterior lobes. On section they show a uniform red color or dirty, rusty grey. They are more solid than normal tissues. There will be more or less frothy mucous in the diseased areas and the bronchi are injected with blood. The lung tissue is firm and dry. The lung pleura over the affected area is diseased but that opposite on the costal pleura is seldom involved. The heart and pericardium remain normal unless the lung is affected in the immediate vicinity. The bronchial glands show enlargement. The abdominal viscera remain normal.

Treatment.—As far as possible, the treatment should be preventive. Pigs that are coughing should not be turned into lots with pigs that appear healthy. Should the disease break out in a litter, the whole litter should be removed from the piggery, the bedding burned and the pen white-washed. The pigs should not be allowed on the range used by other pigs.

The treatment of the disease itself consist in securing dry, clean quarters, as little exposure as possible, rich but not bulky food, and trust that age will help give resistance. The administration of creolin or coal tar creosote preparations at the rate of a teaspoonful to the hundred pounds of weight has a good effect. It is best given mixed with the milk.

ACTINOMYCOSIS.

Causes.—Actinomycosis is an infectious disease commonly seen in cattle, but may occur in hogs. The specific cause is a fungus, *Cladothrix actinomyces* or ray fungus. Its natural habitat is on plants (barley, wheat, etc.), and it has been found on the awns or beards of these grains imbedded in the tongue of hogs. The fungus gains entrance to the body through a wound in the mucous membrane of the mouth or in some other part and may follow castration. Inhalation of the fungus will cause the disease.

Symptoms and Lesions.—These occur as a result of the fungus multiplying in the tissues and causing them to break down. Tumors form on the jaw or in any part of the body as a result of the infection. Frequent-

ly the lungs are affected. When the disease is generalized, the pig presents an unthrifty appearance. As in tuberculosis, the disease may not be recognized until the pig is slaughtered.

The fungus appears in the affected tissues or in the pus from an abscess, as very small yellow granules that can be seen with the naked eye. These granules when placed under the microscope are found to be made up of rosettes, each one composed of a number of club shaped bodies radiating from a central mass which is composed of the mycelial part of the fungus, a fine thread like structure. The clubs vary in size, but are usually from 1_{μ} to 10_{μ} long.

Treatment.—The most practical method of handling actinomycosis in pigs is to send them to the abattoir. In most cases the lesions are localized and the part is tanked. If generalized,the animal should be condemned. If we desire to treat the pig, twenty grains of iodide of potassium can be given in the feed daily for at least two weeks, or until symptoms of iodism are produced. The drug must be then discontinued, and if the tumor does not become smaller in a few weeks, the treatment should be repeated.

ANTHRAX.

Some literature on diseases of the hog regard hog cholera and swine plague as forms of anthrax. Formerly this error was not well understood by swine breeders, and undue prominence was given to a disease that is rarely seen in hogs outside of permanently infected sections of the country. We have never seen a case in this State.

Causes.—Anthrax is caused by an organism, *Bacillus anthracis*, and is found in the diseased tissue from animals affected with the disease. If the tissues of an animal that has died of this affection are exposed to the air, the germ will form spores which are very resisting to destructive agents. When once these spores are introduced into a locality, they tend to remain there for years, and whenever the conditions are favorable, will cause an outbreak of anthrax. These spores are frequently carried on the hides, wool, hoofs, horns, etc., removed from cattle having anthrax, and outbreaks may occur as a result of the refuse from tanneries infecting

pastures on which sheep and cattle graze. Hogs are not very susceptible to anthrax, and the common mode of infection is by feeding on the carcass of some animal that has died from the disease. Cases have been reported, however, where the disease was due to inoculation with the germ.

Symptoms.—The pharyngeal and intestinal forms of anthrax are the most common in the pig. The animal is feverish, the breathing labored and there is difficulty in swallowing food. The pig is very weak and disposed to lie down most of the time. A swelling may appear in the intermaxillary space and spread along the course of the treachea and the neck is usually stiff and saliva dribbles from the mouth. The skin is sometimes stained with blood, the mucous membranes cyanosed or dusky brown. Ulcers may form on the mucous membrane lining the throat, tongue and palate. Carbuncles sometimes form on the skin, especially on the back. Death occurs from suffocation.

Lesions.—The blood is tar-like in appearance, and hemorrhages varying in amount from small petechial spots to a permeation of the organ or tissue are seen. Submucous, subserous, and subcutaneous gelatinous and serous infiltrations occur. At the seat of the inoculation the tissue may be necrotic. The spleen is enlarged and there is a parenchymatous inflammation of the liver and kidneys. In the very acute cases these changes are slight. The longer the course of the disease, the greater are the changes in the tissues. The bacillus anthracis is present in the diseased tissue and in order to confirm a diagnosis, we should prove its presence.

Treatment.—Hogs should not be allowed to feed on the carcass of an animal that has died of anthrax. Preventive precautions are all that is necessary and no serious losses will occur if the dead animals are disposed of in the proper manner.

RABIES. HYDROPHOBIA.

Madness.

Rabies is one of the oldest known infectious diseases. Hogs do not suffer as extensively from it as do dogs, cattle and horses, but wherever an extensive outbreak of rabies occurs, hogs are usually reported as dying from the disease.

Causes.—The specific cause of rabies is not known, but its being due to

a specific germ cannot be disputed. Rabies is a disease produced by inoculation, and in most cases is due to the bite of a rabid dog. The saliva of all animals infected with the disease contains the virus of rabies, but carnivorus animals are the only ones that have a very good opportunity to bite other animals when affected. However, the saliva from any rabid animal, if rubbed into a wound or break in the skin may produce rabies. Hogs sometimes show a disposition to bite and may infect other animals. The average period of incubation is from two to three weeks.

Symptoms.—Rabies in hogs is characterized by very much the same train of symptoms as occurs in other animals. The hog is very restless and excitable, and if lying down or hidden in the litter may jump up suddenly, squeal and run about as if pursued. They will back up as closely as possible in the corner of the pen. The squealing has a peculiar crying sound. They are very nervous and easily startled and will break for a person or other stock. The eyes are at times fixed or may roll about, and there is an abundant secretion of saliva. Frequently they will gnaw the boards of the pen and make desperate efforts to get out. They will bite other animals and swallow indigestible substances. Swallowing is difficult on account of the early paralysis of the muscles of degluition.

The duration of the disease is short. Paralysis occurs early and the hog lies or hides in the litter most of the time and pays no attention to its surroundings. It becomes weak or emaciated and dies in a few days.

Lesions.—The changes in the tissues are neither constant nor specific. The most constant lesions are microscopic in character and are found in the brain. A congested condition of the mucous membrane lining the pharynx, larynx and stomach, enlargement of the spleen and hyperemia (congested condition) of the brain are sometimes seen. Frequently the stomach contains foreign matter, such as stones, straw, pieces of wood, etc.

Treatment.—The treatment of hogs in any way is not practical. As soon as a hog develops rabies, it should be destroyed or isolated in order to prevent its spreading the disease.

TETANUS.

Lockjaw

Causes.—Tetanus is caused by a specific germ, *Bacillus tetani*. This organism exists in most soils but is more common in some localities than

in others. In warm climates it is more abundant than in cold, and dirt rich in organic matter seems to be the favorite place for it.

It enters the body by way of a wound, sometimes so slight as to escape observation. It may follow as a result of castration, and any deep or punctured wound that is not open to the air is a suitable place for its development. Tetanus germs differ from some of the other forms in that they do not enter the circulation and become distributed to different parts of the body, but remain at the point of infection. There they manufacture poisons (toxines and ptomains) that are taken up by the circulation and have an action on the nervous system similar to strychnine.

Symptoms.—The acute form of the disease is usually seen in hogs. The spasms begin with the muscles of the jaws and face, and spread rapidly to other parts of the body, involving especially the back and limbs. Shortly, the hog becomes unable to stand, falls on its side and can not get up. It remains in this position with the limbs extended and rigid. The respirations are labored; frothing at the mouth is noticed and convulsions may occur. The protrusion of the third eyelid is characteristic of this disease. It is very fatal in pigs.

Treatment.—This is limited to preventive treatment, and consists in taking all the necessary precautions against infection at the time of castration and spaying. Medicinal treatment is of little use. The hog should be placed in a pen by itself and kept as quiet as possible. If it will eat, a sloppy diet should be offered. The bowels must be kept open by injections and cathartics.

SIMPLE PYAEMIA AND SEPTICAEMIA.

Blood Poisoning.

There are two forms of blood poisoning. In the first the germs are picked up by the blood stream while passing a wound and distributed throughout the body. The result is to cause abscesses or boils in various places, on the surface, and in the organs, as the lungs, liver, kidneys. etc. The distribution may be local instead of general and we have the infection following up a leg or spread out in the body. Its characteristic is the extension of pus. This is known as pyaemia.

In the second form there are pus germs present at the wound or point of infection but instead of these being carried away by the blood

they remain, and as they grow, produce a poison and this is absorbed and carried about. This may produce profound general shock to the system or inflammation of certain organs. Both conditions may be present at the same time.

Causes.—These are the pus producing microbes, especially staphylococcus pyogenes aureus or albus and streptococcus pyogenes, that enter the tissues through bruises or abrasions permitting the germs to become lodged beneath the skin, or through extensive wounds. Sometimes they remain at the point of infection, but may be transferred from here by the blood stream to distant points, forming suppurating centers or infect the tissues generally and become widely distributed. This condition is not rare as a result of putrifactive changes in the uterus following an inflammation of the organ, or as a result of retention of the foetus.

Symptoms.—Unless the symptoms follow an extensive infection resulting from a difficult birth, an operation or a large wound, the owner does not connect them with a disease of this nature. At the point of infection, an abscess may form or the part become greatly swollen and oedematous. The body temperature is elevated and in serious cases the appetite becomes impaired. Muscular tremors may be noticed, and the hog becomes dull and stupid. It is generally seen hiding in the weeds or litter or in some cool, quiet place. Sometimes the animal has a diarrhoea. In serious cases, it becomes greatly emaciated and death takes place in a few days. Recovery frequently occurs, and in time the hog begins to thrive.

Treatment.—The treatment is mostly preventive, and consists in proper care being given most wounds, especially if extensive, and in using antiseptic precautions in all operations on the pig. Abscesses should be opened promptly and at the lowest point, so that all the pus can drain out. The after treatment consists in washing the cavity with an antiseptic wash for a few days, and the opening should not be permitted to close until the cavity has entirely filled in. In large wounds we must try to bring about the formation of a healthy granulating surface as soon as possible. If necrotic or dead tissue forms in the wound, it must be removed and a healthy surface promoted by the use of antiseptic dressings. In cases of local septicaemia, this is all the treatment necessary. When the disease is generalized, the treatment is usually hopless. Alcohol, salicylate of soda, and quine are the drugs usually given in these cases.

Plenty of clean water should be allowed. The animal should be coaxed to eat easily digested and highly nutritious food in order to prevent its becoming weak.

INFECTIOUS ARTHRITIS.

Causes.—This disease occurs in pigs a few days old and is caused by septic germs that enter the system by way of the navel or umbilicus. Filth and dirty pens are among the predisposing causes. If the disease has once occurred in a pen, it is very apt to recur from year to year. Sometimes it assumes the proportion of a local epidemic and causes very heavy losses in a neighborhood.

Symptoms.—The pig becomes very weak, refuses to suckle, is feverish and usually has a diarrhea. The affected joints are swollen and painful. Abscesses form in different parts of the body, sometimes about the umbilicus and may contain considerable pus. Occasionally the abscesses about the joints break or one of the feet drops off. In case the pus is along the umbilicus, it may discharge outside and recovery takes place. If it discharges into the abdominal cavity, death is sure to occur.

Treatment.—This is wholly preventive. If the disease exists in a litter, the pen should be thoroughly disinfected and the bedding burned. Sows should not be permitted to farrow close to an affected litter, or in a pen where an affected litter has been kept, unless it has been well cleaned and disinfected. Washing the umbilical cord with a ten per cent solution of creolin or carbolic acid should be practiced when the disease is present in a herd. This will cause the cord to become hard and dry, and will prevent the entrance of the germs as well as disinfect the cord.

PARASITIC DISEASES.

THE HOG LOUSE.

But one specie of lice attack hogs. It is a common parasite, however, and often appears in formidable numbers on unthrifty pigs. The hair affords the lice but little protection, and vigorous, healthy hogs are able to dislodge the pests by rubbing against the sides of the pen and against one another. When hogs reach the abattoir during the warm weather,

the adult louse is seldom found on them, but plenty of "nits" are usually seen. The lice become dislodged during the shipment and in the pens by the frequent soakings with water that the hogs receive, and by their rubbing against each other.

It is only when a hog is unthrifty or sick that lice are a serious menace to the animal. When in this condition, the hog seems to be unable to dislodge them and they multiply very rapidly. The bite of the hog louse is very irritating and it lives by sucking the blood of its host. The

The hog louse and eggs.

irritation from the bites makes it almost impossible for the hog to rest, and if sick, they help to increase the anemic (bloodless) condition. Lice are a serious handicap to growing pigs, interfering with their appetite and general nutrition. They are said to cause urticaria (nettle rash or heat sores).

Because of the thinness of the hair and the size of the parasite, it is quite easily seen. The favorite seats are back of the ears ,along the neck, under the breast, back of the arms and on the inside of the thighs, in fact

any place where the skin is moderately thin, and it is not easy to dislodge them.

The hog louse, (*Hæmatopinus uris*, Nitzsch) is one of the largest species of the family. When full grown it measures a fourth of an inch or more in length. Its general color is gray with the margins of the head and thorax and most of the abdomen dark. The head is quite long, the sides nearly parallel, with strong eminences just back of the antennae which are set on the side of the head midway from rostrum to occiput; the legs are lighter with dark bands at the joints; the spiracles are enclosed by a black, chitinous eminence, and there is a broad, black band broken near the middle on the last segment.

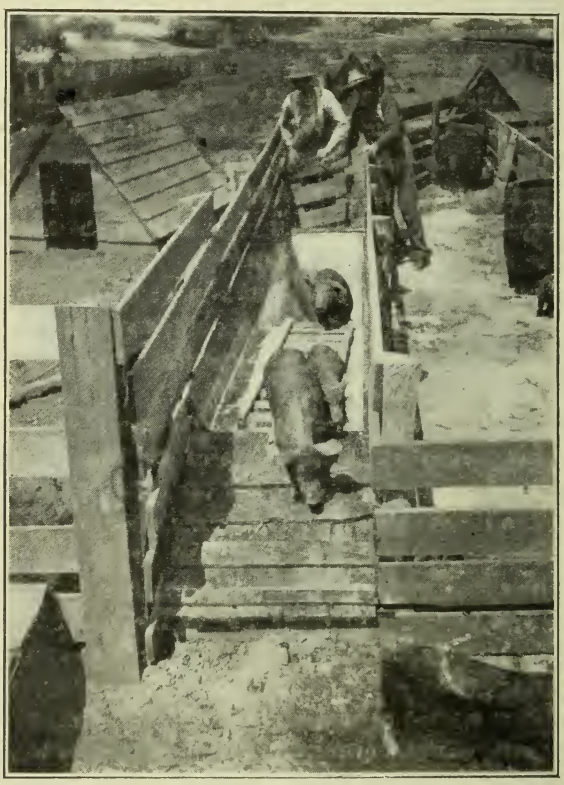
The male has the abdomen marked beneath with a large black area extending forward from the terminal segment. On the feet is an organ that helps the louse to cling to the hair.

The eggs are six-hundredth of an inch in length, by three-hundredths of an inch in width, are slightly yellow or dusky whitish in color, and taper somewhat toward the point of attachment. They are usually attached near the base of the hairs.

Treatment.—It is more difficult to kill the lice scattered around the hog houses and yards than it is the ones on the hogs. For this reason it is difficult to get rid of the lice in a drove of hogs, as they again become infected in the sleeping quarters or about the pen. The hair affords but little protection and makes the application of remedies for their destruction quite easy. A number of different remedies and methods of applying them can be used. Kerosene, any of the coal tar products and crude petroleum are common remedies. The hog can be sprayed or dipped with these preparations.

An ingenious method of applying the oil is by means of the rubbing post. A good solid oak post a foot or a foot and a half in height is placed in position in the hog lot. One hole is bored in the top to a depth of about eight inches, and two at right angles from the sides, at the bottom of the vertical hole. Soft pine pins are driven in the side holes. The upright hole is filled with kerosene and stoppered. Next a burlap strip eight or ten inches wide is wrapped around the post over the side holes. This after a time becomes soaked with kerosene and the pig will rub against it at the place where it will do the most good. It is not, however,

a very thorough way of using the remedy. A better way is to use a spray pump having an attachment for mixing the oil and water. Five parts of water and one part oil should be used. Three or four sprayings are required to kill all of the lice, and should be done at intervals of a week



Dipping vat for hogs.

and in the evening. If done in the evening, by the next morning the oil is evaporated and there is no danger of the sun blistering the skin, as would be the case if applied during the early part of the day.

The coal tar preparations are to be preferred as remedies for lice. These are zenoleum, chloronaptholeum, milk oil, daytholeum and a number of others. The hog can be sprayed or dipped with any of these pre-

parations. Dipping is to be preferred and is a very effective method of getting rid of lice. Pigs a few weeks old can be caught and immersed in a barrel. If a large number are to be treated, it is best to have a dipping tank. The tank should be sunk in the ground and contain enough of the solution to cover the hog when it jumps into it.

Crude oil is the cheapest material to use as a dip. The tank is filled with water to the desired depth, and one inch of the oil poured on the top of it. The hogs are then driven through, and a thin layer of oil is deposited on every part of the animal.

MANGE. SCABIES.

This affection of the pig is frequently alluded to in journals devoted to the swine industry, and is described in nearly all of the old works on diseases of swine. It is a rare affection and of little economic importance. Because of the disease being so frequently mentioned, we include it with the other parasitic diseases, although we have never seen a case in this state.

Hogs have two forms of mange; the sarcoptic form, due to the *Sarcoptes scabies* var. *suis*, and the demodetic form, due to the *Demodex folliculorum* var. *suis*.

The demodex of the pig, (*Demodex folliculorum* var *suis*, Simon) is a worm like parasite, shaped something like a laurel leaf and about one one-hundredth of an inch in length and one-fifth as broad. It comprises three parts; head, thorax, and abdomen, the first two being joined in a single organ. The mouth parts are horse shoe shaped. Their length and the cephlo-thorax is about equal to the length of the abdomen. The mouth parts comprise, first a pair of mandibles; second a pair of jaws; third a narrow tongue. On the sides of the thorax are four pairs of short, mobile legs formed of three parts, the last part being fitted with two claws. The abdomen is long, conical and striated transversely. It shows at the anterior part of its ventral face a longitudinal slit, the anus, which is much larger in the female than in the male, and may serve for copulation and ovulation. The abdomen of the male is less developed than that of the female, and possesses a genital armature situated immediately in front of the anus.

The young parasites are small and narrow and have but three pairs of legs. The eggs average twenty five-hundredths of an inch long and are ovoid in shape. The larva undergo three metamorphosis before reaching the adult state. It no doubt passes through the different stages of development in the follicles of the skin, but may migrate over the surface of the skin when they reach the adult stage and before laying eggs.

Symptoms.—The finer parts of the skin are affected; the snout, neck, chest, abdomen, flank and inner part of the thighs. The inflammation begins in the region of the hair follicles and sebaceous glands. Pimples and pustules appear, varying in size from that of a grain of sand to that of a hazel nut. As the disease progresses large purulent islands varying in size and containing many acari are formed. Ulceration may follow. In the older diseased areas and when the disease lasts for a long time, the skin becomes sclerotic (hard) and many times its normal thickness. Inside of the pimples the mites can be found in all stages of development. In the small abscesses there may be from fifty to one hundred, in the larger ones a thousand. Follicular mange is said to be more contagious in the hog than it is in other animals, and is considered a serious disease.

The scab mite (*Sarcoptes scabeii* var. *suis*. Lahr,) is one of the largest of the specie and when found, can be seen with the naked eye. They work deep in the skin, and it is difficult to find them. The female is about one-fiftieth of an inch long and almost as broad. The male is not as large. The mite has eight very short, thick, conical shaped legs, the two posterior ones being quite, or almost concealed beneath the abdominal surface. On the dorsal surface are a number of parallel ridges interrupted by conical projections. Toward the posterior part of the body are a few hairs.

Symptoms.—It begins with a violent itching about the head, especially at the base of the ears, about the eyes, and gradually extends to the neck, withers, inner surfaces of the thighs and the whole body. The invaded areas of the skin are first covered with little red pimples. Abrasions from the hog rubbing itself soon occur. The secretions and scales from the skin gradually accumulate, the bristles drop out or become matted and the skin is greatly thickened and wrinkled. In old cases the scales on the skin give it a dirty white color.

The mites live in galleries in the deeper layers of the skin and they multiply rapidly. Hog mange is not communicable to other animals.

Treatment.—Hog mange is difficult to treat. It does not seem to spread rapidly among hogs, and can be controlled by isolating or destroying the affected animals. The pig houses and pens should be disinfected, or the pigs moved to fresh quarters after being treated. The skin must be rubbed with a strong alkaline soap before applying the remedy in order to remove as many of the scabs as possible. A tobacco dip can be used, but in severe cases a mixture of eight parts of turpentine and one part flowers of sulphur is a better remedy. It is best to apply the remedy with a brush and rub the skin quite hard. Sulphur or nitrate of lead ointment may be applied when the infection is slight.

INTERNAL PARASITES.

THE COMMON ROUND WORK.

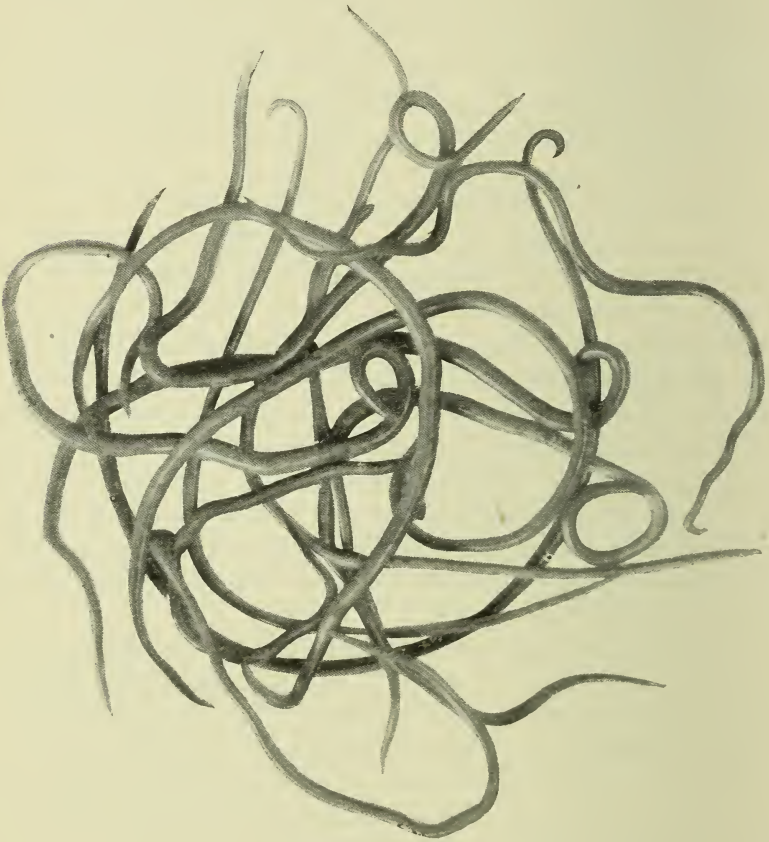
Ascaris Suilla.

The natural habitat of the common round worm is the small intestine. It is sometimes found in the large intestines and the stomach. Its presence in the stomach occurs only when the hog is dead, and is reached by a reverse peristalsis of the intestines or the movement of the worms themselves. When quite active and present in large numbers, they may work forward into the oesophagus. It is not uncommon to find them extending into the common bile duct, some even enter the gall bladder, while others imbed themselves in the ducts coming from the various lobes of the liver.

In young unthrifty pigs round worms are common parasites, and it is not unusual to find from ten to twenty of them in a single individual. They may be present in such numbers as to almost fill the lumen of the intestines for several feet of its length. There are few pigs over the country that do not harbor this parasite to a greater or less extent. Men who treat hogs for cholera and swine plague, are quite familiar with this worm, and report it as being quite common.

Description The *Ascaris suilla*, Dujardin, is a large round worm, tapering at both ends, and white, or yellowish white in color. The body is firm and elastic, the digestive tract quite complete. The average length of the female is ten inches, that of the male six and a half inches. The head is small and armed with three lips, the upper one having a papillae at each

of its inferior angles, the other two at the middle of their base. The female organs consist of a pair of convoluted tubes, each dilating into a uterus and uniting to form a single tube, the vagina. The opening from the vagina, the vulva, is situated toward the anterior third of the body in



Large round worms.

the middle of an anular constriction. The male organs are simple, consisting of a single convoluted tube dilated below to form a seminal vesicle, and terminating in an ejaculatory duct which opens into the cloaca. The posterior extremity is furnished with a large number of papillae, some

of which are back of the anus. The ova are about one four-hundredths of an inch in length.

Source of Infection.—The eggs of the ascaride are passed out with the excreta and drop to the ground. Moisture and warmth are necessary for their hatching, but they seem to be able to live under unfavorable conditions and will resist drying for some time. When the conditions are favorable, the eggs hatch and the pig becomes infected by taking the immautre form into the digestive tract along with the food, or the embryo, when well formed in the egg, reaches the digestive tract with the food, the shell is dissolved by the gastric juice and the embryo liberated. Earth eating pigs are almost sure to become infected. Feeding hogs on dirty feeding floors or on the ground, and drinking from ponds and dirty watering troughs are common sources of infection. The best of hygenic conditions may not prevent infection, but will greatly lessen it.

Symptoms.—Unless a number of ascarides are present in the intestines, no marked symptoms of disease occur. Whenever the pigs are kept under conditions unfavorable for growth, they usually become infested with a large number of intestinal parasites, and the irritation to the intestines will help in causing the animal to become stunted. They also obstruct the passage of the food along the intestines, and the maintenance of the colony of worms taxes the animal to some extent. The symptoms shown do not differ greatly from those seen in chronic indigestion. The presence of worms in the faeces help very much in diagnosing the trouble. Pigs weighing from twenty five to one hundred pounds are the most frequent sufferers. In thrifty old hogs, they are never present in large enough numbers to cause any harm. Young hogs are sometimes very restless, and may manifest other nervous symptoms.

Treatment.—The preventive treatment is very important, and consists in bettering the sanitary conditions under which the pigs are kept. Wallow holes should not be allowed to form in the yards, the water supply should come from a deep well, and clean feeding floors and watering troughs provided as far as possible. To enable the pigs to resist invasion, they should be kept in good condition.

To destroy the worms or drive them out of the intestines, a number of different drugs can be used. The simplest treatment for intestinal worms is turpentine in milk. The dose given is one teaspoonful of tur-

pentine for every eighty or one hundred pounds of live weight, and is more effective if repeated three days in succession. A mixture of powdered areca nut and worm seed in teaspoonful doses is also recommended.

Large round worms as found on opening the intestine.

Santonin five grains and calomel three grains for every eighty pounds of live weight is a very effective remedy for round worms. All powdered drugs are best given in ground feed and should be well mixed with it,

or each pig will not get the proper dose. In dosing a large number, they should be divided into small bunches and each bunch dosed separate. The best results are gotten when the pigs are starved for about twelve hours before giving the remedy, and when a physic is given along with it or immediately after. Castor oil or calomel are the physics usually given, especially the latter, as it is very effective and can be readily given along with powdered drugs. Turpentine need not be followed by a purgative.

THE THORN HEADED WORM.

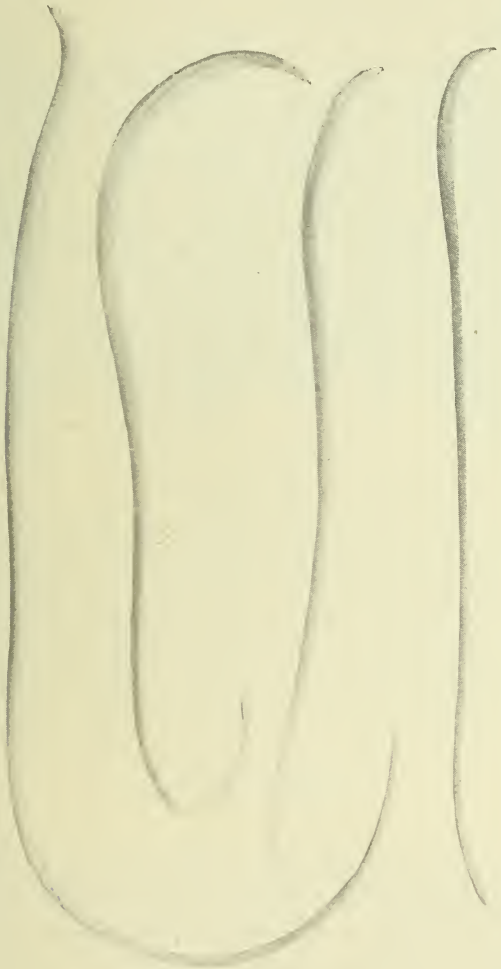
Among the parasites of the small intestines occurs one specie of the genus Echinorhynchus. It is usually found with its proboscis imbedded in the wall of the small intestine, well toward the anterior part. It is seldom found in the large intestines. The round and thorn headed worms are frequently present in the same animal, but the two genera are quite distinct, and the most careless observer is able to distinguish between them. The echinorhychus is not as common as the ascaride, and is not found in as large numbers. It is uncommon to find more than five or six thorn headed worms in the one animal. The loss occasioned by this parasite some years is quite large. A single slaughter house in this state estimated their losses at $7,000 due to poor sausage casings. This must be only a trifle compared with the loss to farmers from lack of thrift.

Description.—The *Echinorhynchus gigas*, Goeze, is larger than the ascaride. The female when full grown is the largest worm infesting hogs. The average length of the male is three inches, that of the female ten inches. The body is milky white in color, irregularly wrinkled transversley and tapering to a blunt point at its posterior extremity. At the anterior extremity is a retractile proboscis or rostellum, almost globular in shape and armed with six or eight rows of chitinous hooks which curve backwards. This organ can be retracted into a muscular sheath to which are attached strong retractor muscles situated toward the anterior part of the body cavity. At the base of the rostellum, and hanging down into the body cavity are two muscular sacks, that are considered by some representatives of a digestive tract. No digestive tract is present. The genital opening in both sexes is at the posterior extremity of the body

The eggs average about one two-hundred and fiftieth of an inch in length, and are smooth and cylindrical in shape.

Thorn-headed worm attached to the intestine.

Source of Infection.—The eggs pass out with the faeces, become mixed with the manure and scattered around the pens and pastures. White grubs which are very plentiful in dung heaps become infested with the immature



Thorn-headed worms.

form of the worm, and act as intermediate hosts. Hogs become infested by eating the grubs which they will search very diligently for in loose

rich soil. The per cent. of infection will vary according to the locality and the season of the year. Those pasturing upon sod, especially clover sod, show greatest infection.

Symptoms.—When a number of thorn headed worms are present in the intestines, they greatly irritate the lining membrane and cause serious symptoms of disease, especially in young pigs. The symptoms as described by observers are loss of appetite, constipation, diarrhea, restlessness, general emaciation, weakness of the loins, and in very young pigs, convulsions and spasms. When the infection is light, no noticeable symptoms occur.

At the point where the worm attaches itself, the intestinal wall is inflamed. The inflamed tissue is about a quarter of an inch in diameter and depressed in the center where the rostellum is imbedded. Sometimes the head of the worm is buried more deeply than the mucous coat, and the muscular and serous coats become inflamed. Perforations of the intestines have been reported, but such a lesion should be questioned. When the intestines are badly infested by parasites, they are easily torn when handled because of the inflammatory changes in their walls, and the tear is sometimes mistaken for a perforation.

Treatment.—As a preventive measure, we should not allow hogs to root around old straw stacks and manure heaps. Sometimes white grubs are very plentiful in old hog lots. Plowing the lots occasionally will help to free them from grubs. The turpentine treatment as recommended for the common round worm is a very effective remedy, and should be given three days in succession. Better results are gotten if the hogs are dieted over night, and the turpentine administered in the morning.

THE PIN WORM.

The pin worm, *Oesophagostoma dentatum*, Rud. is quite small. It inhabits the caecum and colon of hogs, and may be found in large numbers in this part of the intestine. Unless looked for carefully, it escapes notice.

Description.—The body is white or brownish in color, straight and pointed at both ends. The male is half an inch in length; the female a little longer. The mouth is circular and surrounded by a ridge on which are several papillae. The caudal pouch of the male is bell shaped and

rounded, with a faintly marked middle lobe. That of the female is pointed. The vulva is situated in front of the anus and surrounded by a raised ring.

Caecum worms.

Pin worms cause but little if any digestive disturbance. Irritation to the walls of the caecum or colon does not interfere as much with digestion, as would an irritation to the stomach or small intestine. They are seldom present in large enough numbers in the intestine to cause any noticeable irritation, but no doubt in conjunction with other parasites, they help to aggravate the symptoms of parasitism. The pig becomes infested through the food supply.

THE WHIP WORM.

Description.—The whip worm, *Trichocephalus crenatus*, Rud, is commonly found in the large intestines, generally the caecum. It is about one and a half inches in length. The anterior two-thirds of the body is capillary and very thin, the posterior one-third suddenly expanded, thick and cylindrical in shape. The caudal extremity of the male is coiled, and a number of short spines are seen behind and around the sheath of the spicule, the point of which is rounded.

Method of Infection.—Pig becomes infected by taking the eggs into the digestive tract along with the food. The eggs usually contain well formed embryos which are said to develop into the adult form in about four weeks.

Symptoms.—No serious trouble is attributed to either whip or pin worms. When present in large numbers, they no doubt cause considerable irritation and may aggravate the symptoms in other parasitic affections.

Treatment.—The same treatment as recommended for other forms is indicated here. In addition rectal injections of soapy water can be administered.

THE KIDNEY WORM.

When a hog is paralyzed in its hind quarters swine breeders usually call the disease "kidney worm." This statement may also be used when the pig is not doing as well as it should. A few years ago the kidney worm was claimed by some to cause hog cholera and swine plague. The origin of these statements is not reliable, and the presence of the worm under such conditions is only a coincidence.

The kidney worm occurs in the fat around the kidney, in the kidneys and sometimes in the liver. It is usually found in cysts or canals and several may be seen in one cyst. They more often occur in pairs. As a result of the irritation, there is more connective tissue in the region of the cysts than in the rest of the fat, and it may contain pus. It is not uncommon to find kidney worms in the pelvis of the kidney, and frequently its walls and the ureter are inflamed and thickened. Sometimes the kidneys are inflammed and contain abscesses. This latter condition in the abscence of the kidney worm is not uncommon.

Description.—The kidney worm, *Stephanurus dentatus*, Dies, is mottled but when seen against the fat appears dark colored. The body is cylindrical, plump, and slightly tapering at both ends. The male is from an inch to an inch and a half in length and about one twenty-fourth of an inch thick. The caudal extremity forms a blunt end, in which is situated the anal and genital openings. Surrounding the body openings is a six lobed bursa. There are two long slender spicules having muscles attached to their upper ends, and when extruded, can be drawn within the

body. The female is some larger than the male and will average about an inch and a half in length and one twelfth of an inch thick. The curved tail has a conical shaped tip and is winged lateraly. The anal opening is very close to the extremity of the tail, and ventral; the vulva

Kidney worms in the kidney.

is situated about one twenty-fifth of an inch in front of the anal opening. The reproductive organs consist of two ovaries, two oviducts, two uteri and a bicornate vagina. The eggs are oval in shape and about one two hundred and fiftieth of an inch in the longer diameter.

The mouth is terminal, circular in shape and surrounded by papillae.

The alimentary tube can be divided into buccal cavity, oesophagus, stomach, intestine, and rectum.

Method of Infection.—The way in which hogs can become infected has never been demonstrated. In all probabilities the eggs pass out in the urine, and the embryo after developing for a time in some moist place or in water, is taken into the body with the food the same as in other parasitic forms. It is believed that no intermediate host is required and the infection occurs direct.

Symptoms.—Hogs affected by the kidney worm rarely show symptoms of disease. In some cases diseased changes are noted in the kidneys and in the fat around them; sometimes the liver shows a few lesions. In these cases the symptoms are the same as manifested in diseases of these organs. This parasite seems to be of little economic importance.

Treatment.—The preventive treatment indicated is the same as for the intestinal forms. It is useless to try and treat them as they are beyond the reach of any medicine, unless by such drugs as are eliminated by way of the kidneys.

THE LUNG WORM

Whooping Cough.

The lung worm, *Strongylus paradoxus*, Mehlis, is a common parasite of pigs under six months of age. It is found in the bronchial tubes. When the infection is slight the worms are found mostly toward the apex and margin of the lungs. In these cases the lesions are not marked, and it is necessary to examine the lung very carefully in order to detect them. In examining lung tissue for this parasite, it is best to cut off the apex, and by squeezing it between the fingers, force the lung worm out of the broncheole onto the cut surface of the lungs, where they can be readily seen. It is the only lung worm affecting hogs, and may occur in sheep.

Description.—The male is a little over three quarters of an inch in length. The bursa is provided with numerous folds; the caudal extremity at the base of the bursa is curved toward the ventral aspect and two long tubular spicules project outside about one-tenth of an inch. The female

is from an inch to an inch and a half long. The vulva is surrounded by a vesicle or bladder like body, visible to the naked eye. Surrounding the mouth are six lobes, the two lateral ones being the largest . The color is whitish or brown.

Lesions.—These are usually slight, and depend on the number of lung worms present or the duration of the infection. The worms are found in the bronchial tubes mixed with the mucous, and when badly infected, the mucous membrane lining the smaller tubes becomes inflamed. As well as irritating the air tubes, it acts as a mechanical obstruction by plugging up the smaller bronchi, and causing a lobular pneumonia. The involved air cells usually return to the normal, but may go through other diseased changes. In some cases the effect is to enlarge the bronchi or to cause saculation.

Method of Infection.—The life history of the lung worm is not fully known. In most domestic animals infection with lung worms depends largely on the humidity of the soil, and is more prevalent on swampy pastures containing ponds and stagnant water than it is on high ground. This disease is more prevalent during wet seasons. Lung worms are often present in pigs when kept under the best possible conditions.

The eggs are laid in the bronchial tubes. Before they hatch it seems necessary for them to be expelled by coughing, and undergo a part of their development outside of the body. Just what these changes are is not known. In all probability the pig becomes infected through the food supply, by rooting in the mud and by inhaling the immature form in the dust that may accumulate about the sleeping quarters and pens, as a result of the mud carried on the bodies of the animals.

Symptoms.—The disease is largely confined to pigs. The first symptoms begin as a cough, occuring upon leaving the bed, after exercise and after eating. In badly infected cases the paroxysm of coughing is quite severe, beginning slowly and becoming harder and harder, and finally the pig will put the nose on the ground and press hard while coughing. The paroxysm ends by the expulsion of some mucous or by vomiting. This is referred to frequently in the journals as whooping cough in pigs. The cough may become frequent and persistent, and is generally spoken of as chronic. In the majority of cases the infection is so slight that the presence of the lung worm is not suspected by the owner. The appetite

remains good in such cases and the thriftiness of the pig is not interfered with. Death seldom occurs and as the pig grows and thrives, it gradually recovers from the affection.

Treatment.—The most important part of the treatment is to keep the pig in a helthy, growing condition. The hygienic conditions in the pastures and pens should be as nearly perfect as possible. The drinking water should be pure and all ponds and mud holes drained or filled in. Clean watering troughs and feeding floors are also necessary. The sleeping quarters should not be allowed to become dusty. Medicine is of little value in this disease. A fumigation of tar or turpentine may be tried if desired. However, more can be accomplished by feeding a highly nutritious ration, and waiting until age will give the necessary strength and resistance to overcome the disease.

ECHINOCOCCUS, HYDATIDS.

The disease caused by the larval stage of the *Tænia echinococcus* Lieb, is known as hydatid, or echinococcus disease. Dogs and wolves act as hosts for the mature form of this tapeworm, and the immature form is found in domestic animals. It is commonly found in the liver, lungs, etc., of hogs and cattle killed in the abattoir. Man may also act as host for the larval form.

Description.—The larval form appears in the form of cysts, generally in the liver, but they may be found in the lungs, heart and various other organs of the body. After four weeks from the time of becoming infected by the embryo, small cysts about one twenty-fifth of an inch in diameter may be noticed in the infected organs. The outer wall of the cyst is formed by the connective tissue of the organ in which it is located. Within this is the young parasite. Its outer part or capsule is rather transparent, the inside granular and somewhat condensed on the periphary and containing cells which are distinctly separated from one another. The cyst grows slowly and at the end of eight weeks has about doubled in size. The elastic cuticle is then much thicker and its inner surface is covevered by a thin membrane, the germinal layer, which represents the condensed granular contents. In the center of the cyst is a cavity containing

a clear watery fluid. As the hydatid grows, the cuticle becomes stratified and the germinal layer becomes differentiated into small cells occupying the periphery, large cells on the inside and granular cells occupying the

irregular spaces on the surface. At the end of nineteen weeks, the parasite is about two fifths of an inch in diameter. Protuberances gradually grow in to the cavity and develop into broad capsules, and it is in these capsules that the head of the succeeding generation of tape worm develops. Numerous broods of capsules may form in one cyst and many thousand heads may be present in the one hydatid. Several modes of growth are open for the parasite. Centers of growth may form in the wall of the hydatid; these are called daughter cysts. In turn a third generation may form in the same manner in the daughter cyst; these are called grand-daughter cysts. As they develop, they will burst through that part of the hydatid wall offering the least resistance, sometimes on the inside of the wall and sometimes on the outside of it. For this reason they are called endogenous and exogenous cysts. When a group of small hydatids lie close together and are connected by a common stroma, they are called Echinococcus multilocularis. Sometimes as a result of the formation of daughter and grand-daughter cysts, they take on the form of a bunch of grapes; they are then named E. racemosus. Sometimes the

hydatid is headless and consequently sterile. This condition is called Acephlocyst, and does not represent the final larval stage.

The changes in the tissues vary. There may be an enormous increase in the size of the lungs or liver. The serous membrane which covers the

Position of the head in hydatius of the brain.

liver is thickened, and may be glued to the neighboring organs. Its surface is uneven, the salient places corresponding to a cyst. There is an atrophy of the liver cells, the amount of connective tissue is increased and forms a capsule immediately surrounding the parasite; the surface of the capsule, which is smooth and glistening, is entirely separated from the cuticle of the cyst. On section the liver is found to be filled with cavities, with the liver tissue between in the form of small islands or ribbons of various dimensions. In time the cysts degenerate into a caseous or gelatinous mass in which we can find the hooks of the larval tape worm.

Method of Infection.—The hydatids develop as a result of the ingestion of the eggs of the adult tape worm. Dogs infested with the adult worm may scatter the eggs in places where they can infect the food or drinking water of the hog. In countries where dogs are numerous, hogs seem to be more commonly infected, and in the region of slaughter houses where insufficient attention is paid to the destruction of the immature form, dogs may become infested by eating the diseased tissues.

Symptoms.—The symptoms are not characteristic and are frequently entirely absent. When the liver contains a large number of cysts, pressure on the right side of the abdomen just over the organ may cause the animal pain. On percussion we find an increase in the size of the liver. If the increase in size is many times the normal, the abdominal viscera are greatly pressed on, the function of the organ is greatly interfered with and digestive disturbances occur. When the lungs are involved, symptoms of pulmonary tuberculosis may be manifested. If any important organ is severly infested, death may result.

Dropsy as seen in hydated disease of the liver. The appearance in the same when caused by other liver affections.

Treatment.—Preventive treatment is of the utmost importance. It consists in destroying all organs infected with hydatids. Dogs known to be infested with the adult taenias should be destroyed. It is dangerous to keep dogs in this condition, as man as well as pigs may become infected. If such precautions were used, the disease could be finally exterminated. This disease is apparently on the increase in this country.

THE LIVER FLUKE.

The common liver fluke, *Fasciola hepatica*, Linn, is more common in cattle and sheep than it is in hogs. Liver flukes are apparently of little importance in hogs in this country. They may affect other organs besides the liver, but this is the chief abode of the parasite. It is generally found in low lands and is more prevalent on wet than on dry years.

Description*.—Fasciola hepatica, L. Body; pale brown, leaf like, flattened, 18-15 mm. long by 4-13 mm. broad. The anterior 3-4 mm. forms a rather thick, conical portion which is followed by a large flat, leaf-like body of elongate, oval form; this latter widens rapidly to the maximum breadth, and then decreases gradually in width to the posterior end which is bluntly pointed; cuticle is covered with numerous spines placed side by side in alternating rows; oral sucker is anterior, round and terminal, but inclines ventral; acetabulum about 3-4 mm. caudad of oral sucker, with which it closely agrees in size; genital pore median, about half way between oral sucker and acetabulum; oesophagus rarely over 1-1-½ times as long as the pharynx; intestine dentritic; cirrus frequently extended from pore and then recurved; testicles profusely branched, situated for the greater part posterior to transverse vitello-duct. Vulva is at side of cirrus; uterus forms a rosette with its numerous coils, and is frequently visible to the naked eye as a dark-brown spot, immediately posterior to the acetabelum; ovary branched, anterior of transverse vitello duct; vitellogene glands profusely branched, and occupy the entire margin of the body from acetabulum to posterior extremity; they lie dorsally as well as ventrally of the intestine, becoming wider posterially. Oviparous.

Eggs; oval, 0.13-0.14 mm. long by 0.075 to 0.09 mm. broad; miracidum conical, ciliated with oval papillae, two cup shaped eye spots, rudimentary intestine; metamorphosis (sporo cyst, redia, cercariae) take place in small snails of the genus Linneae; (L., trucatula, and others.) Cercaria whitish, owing to excessive development of capsule glands; encysts upon plants.

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*Stiles, Ch. Wardell and Hassell, Albert—

Journal of Comparative Medicine and Veterinary Archives, XV. pp. 302 ,1894.

Life History of Fluke and Method of Infection.—Although the life history of fluke is of little importance to us at present, it is well for us to know something about their development. Their life history in brief is as follows: Each adult worm is capable of producing an immence number of eggs (thirty seven to forty five thousand.) These pass down the billiary passages into the intestines and become mixed with the faeces. Those that reach some favorable place for development after a long or short period of incubation (from ten days to three months) depending on the amount of heat and mositure, become a ciliated embryo. The ciliated embryo (Miracidium) swims around in the water and seeks certain snails (Linnea trucatula, L. oahuensis, L. rubella), penetrates into the respiratory cavity of these animals and encysts. The sporocyst, which it is now called, at the end of about fourteen days is about one fiftieth of an inch in length, and the germ cells present develop into a third generation, known as rediae. The rediae escape from the sporocyst when the latter is from two to four weeks old. They then wander to the liver of the snail and from the germ cells present in the body cavity of the parasite develop the next generation, the cercariae. This latter form resembles the adult parasite. It may remain in the body of the snail for some time or pass out and attach itself on the grass or acquatic plants around the margins of the pond and encyst. The different animals become infected from eating these snails along with the food, or from eating grass infested with the cercariae. The development will last from ten to twelve weeks. Each sporocyst may give rise to from five to eight rediae, and each rediae to from twelve to twenty cercariae.

Lesions and Symptoms.—These are directly dependent on the presence of the flukes in the body, and as the liver is the organ generally affected and the chief abode of the parasites, the principal lesions are in this organ. The flukes are confined to the gall ducts, but may pass out into the proper tissue of the liver. There is a catarrhal inflammation of the bile ducts. The smaller ones may become dilated and form cysts. The inflammatory processes extend from the ducts to the connective tissue of the liver and it becomes hypertrophied, and the liver cells are destroyed to some extent, depending on the amount of infection, and a large portion of the liver is a mass of cicatritial tissue. The gall is changed in character,

is less thick, greenish brown or dirty red in color and contains liver cells blood cells, etc.

These changes in the liver and in other organs as well, lead to changes in the body nutrition and the animal may become anemic, weak and emaciated.

THE LUNG FLUKE.

The lung fluke, *Paragonimus Westermanii*, is sometimes found encisted in the lungs of hogs killed in the abattoir. Dr. A. J. Payne, chief inspector in charge at Cincinnati during the latter part of 1898, found one per cent. of the hogs killed in the abattoir affected with this parasite. The hogs were in good condition and only a few cysts were found in each lung. The muscle flukes in American swine are probably young specimens of the lung fluke.

Its complete life history has not yet been determined, but according to present knowledge the worm does not develop until after it leaves the host in the sputum. Some observers have succeeded in raising the embryonic stage, but beyond this nothing positive has been demonstrated. This worm has been found in man, cat, dog, tiger and hog.

PORK MEASLES.

Measles of the pig is a parasitic disease caused by the *Cysticercus cellulosæ*, Rud, a larval form of the Taenia solium, a tape worm sometimes found in man. The frequency of measles corresponds with that of the tape worm, as the pig becomes infected by eating human excrements which contain segments of this parasite.

The bladder worms or cysticerci are found in the muscular tissue, especially in the region of the abdomen, in the tongue, heart, neck, shoulders, pelvis, flank and superior regions of the legs. They may be found in other organs as well. The adult cysticerci represents a small vesicle about the size of a pea or bean, of a dull white color and provided with a head and neck. This is marked externally by a dark spot which is bent in toward the inside of the vesicle.

Method of Infection.—Man harbors the adult worm, Taenia solium, and hogs become infested with the larvae by taking into the digestive tract the segments of the parasite that are passed out with the faeces. These contain a large number of eggs and on reaching the stomach are

freed from their shells by the dissolving action of the gastric juice. The embryo is then free, perforates the intestinal wall, or enters a small blood vessel and drifts along in the blood stream until it reaches a suitable place to develop. Nine days after infection a small oval vesicle forms in the infested tissues. In twenty days, the bladder worm is about as large as the head of a pin, and in sixty days it has grown to about the size of a pea. It is then enclosed in connective tissue and has fully developed, and at the end of this period a well formed neck can be seen.

Degenerative changes take place quite early. The connective tissue capsule becomes infiltrated with lime salts, and gradually the whole parasite undergoes a calcareous degeneration.

Symptoms.—There are no definite symptoms. Some investigators have described as symptoms of measles, a hoarse voice, falling out of the hair, depression, loss of appetite, weakness, emaciation, a partial paralysis, diarrhoea and oedematous swellings in the region of the head, neck and shoulders. A more postive diagnosis may be made by examining the visible mucous membranes of the mouth, especially in the region of the tongue, for the characteristic lesions. When the tissues in these parts are affected, small pimples may be felt or seen on the mucous membrane. Blindness, rabiform symptoms, etc., have been reported in cases of general infestion of the tissues, and within a variable time exhaustion and death.

Treatment.—This is wholly preventive. Pigs should be prevented from ingesting the fecal matter of man by using proper precautions.

The importance of this parasite lies in the danger of man becoming infested with the adult worm. The Taenia soleum is an armed tape worm and gives rise to much more serious symptoms than the more common unarmed form. The infection results from the eating of uncooked pork. Man may also become infested with the cysts. This may occur in various ways; as a result of a reverse peristalis of the intestine carrying a gravid segment into the stomach, from a contaminated water supply and from the hand becoming soiled at the time of defecation. In man the bladder worm may develop in the eye or brain, and give rise to very serious symptoms.

The preventive treatment consists in tanking the parts infested with cysts and eating only well cooked pork.

BLADDER WORMS.

The bladder worm, *Cysticercus tenuicollis*, Leuck, is another tape worm larvae occurring in the body cavity of swine. It is also found in cattle and sheep. The adult tape worm, *Tænia marginnata*, Batsch, is found in dogs and wolves. These bladder like bodies are a half an inch or more in diameter and are usually found on the folds of the omentum.

Method of Infection.—The eggs of the Taenia marginata pass out with the excrement of dogs and become scattered around on the ground. Infection takes place the same as in some of the other parasitic forms, the egg containing the six hooked embryo entering the digestive tract along with the food. The embryo on reaching the stomach and intestines is liberated by the digestive juices. It then migrates from the intestines, either by crawling or by drifting along in the blood until it reaches the liver. About four days after infection, it can be seen in this organ, lodged in the finer branches of the blood vessels which it transforms into tubes, and having the appearance of a small round kernel. After remaining here for a short time, it leaves the liver and falls into the body cavity and usually encysts on the omentum. Here it remains until fully developed, which requires several months. In time, as is the case with the cysticercus, it undergoes degenerative changes. If the cyst is eaten by a dog the scolex or head is freed from the cyst by the digestive juices, and the suckers and hooks attach themselves to the wall of the intestine and development of the segments of the tape worm begins.

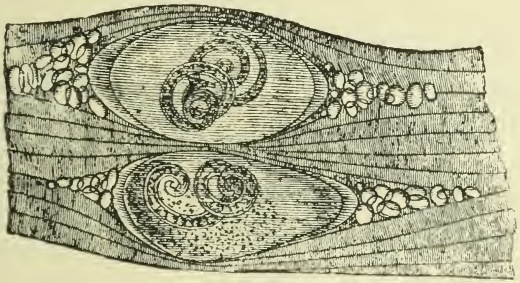
Symptoms.—The symptoms produced by the bladder worm are not noticeable. No deaths have ever been reported in hogs from infection by this worm. When the infection is heavy, inflammation in the body cavities as a result of the migrations of the larvae may occur, but the symptoms manifested by the animal are not diagnostic. It is hardly possible to recognize the disease in the living animal, and if it could, the treatment would not differ from that recommended in peritonitis and pleurisy.

The lavrae of the Taenia marginata is not of as much economic importance as the larvae of the Taenia soleum. It does not cause as serious a line of symptoms in its host as the cysticercus, and does not infect man.

TRICHINOSIS OF THE PIG.

Trichinosis is a disease caused by the muscles of the body becoming infested with a very small round worm, the *Trichina spiralis*, Owen. The disease is seen in man and other mammals. It occurs in two forms in the one animal; the intestinal, which represents the adult parasite, and the muscular, which represents the larval stage of the parasite. From one to three per cent. of the pork examined contains trichina.

Description and Life History.—The adult T. spiralis is a very small worm. The male a little over one twenty fifth of an inch long, the female about three times the length of the male. The digestive tract can be divided into a buccal opening, oesophagus, stomach, intestines, anus and



Trichina in the muscle. From Neumann.

cloacal slit. The genital apparatus in the male consists of testicular tube, excretory canal and genital orifice; in the female of ovaries, uterus, vagina and vulva. Internal impregnation takes place, and the eggs develop in the uterus of the female to the number of at least a thousand and are born alive. These embryonic worms within a short time after birth penetrate through the walls of the intestines and migrate through the tissues until they reach the involuntary muscles. It then enters the muscle fibre, coils itself up and rests. In about two weeks, the cyst can be seen and embryos become transformed into larvae. The tissue in the neighborhood of the embryo, is the seat of cellular infiltration, and the muscles in the region may become swollen, and undergo more or less degenerative changes. Connective tissue forms in the region of the parasite and the cyst containing one or more larvae, is spindle or lemon

shaped. The larva is about one twenty-fifth of an inch in length. The formation of the embryos begin about the seventh day after the cysts are taken into the digestive tract. The emigrating period is prolonged to the second or third week, and the encysting period from the fourth week to the third month. After the third month degenerative changes begin in the cyst and finally involve the larvae as well, but these changes (calcareous degeneration) may take place very slowly and not occur for a year or more. When the cyst does become calcified, danger to the infested individual is over. One ounce of the flesh of an infested pig may contain eighty five thousand encysted worms.

Method of Infection.—Infection occurs from eating flesh containing the live larvae of the T. sprialis. The source of the infection in swine is from eating rats. According to the investigations made by Stiles, rats around the country slaughter houses are quite generally infested with trichina, as it is rare to find the offal in country disposed of in the proper way, and rats are abundant around such places. Hogs frequently have the same opportunity as the rats to feed on offal and under such conditions infection may occur.

Symptoms.—These have been observed in experimental animals and in man. When only a few embryos migrate through the tissues, but little body disturbance is noted. The disease is characterized by two groups of symptoms; one affecting the intestinal canal, the other the muscles.

From the beginning of the first to the end of the second week after infection, gastro intestinal disturbances are noticed, but the symptoms are not constant. The appetite is lost, the hog is depressed, abdomen tense and the animal may vomit. Colicy pains accompanied by a diarrhoea may occur. When the parasites are present in large numbers, it may lead to a rapid death, but if only a few are present the sympotms of disease may end in this stage.

The muscular symptoms are due to the inflammation caused by the migration of the parasites. They are observed from the second to the third weeks. The pig may rub and scratch itself, symptoms resembling rheumatism occur, and the animal is stiff, sometimes paralyzed. Respirations are difficult, it can hardly masticate and swallow its food, and the voice is much changed. Oedematous tumifactions may appear in various

regions and the pig loses flesh very rapidly. Pigs generally recover in about five or six weeks.

Treatment.—The treatment is preventive. The offal around slaughter houses should be disposed of in the proper way. Hogs should not be allowed to eat this refuse and if kept around abattoirs at all, should be fed grain. If the symptoms of the disease are marked and a correct diagnosis can be made, all that can be done is to destroy the animal. As this disease is communicable to man and is often followed by fatal results, only well cooked or well cured pork should be used as food. It is impossible for the parasite to survive the proper cooking or curing of the meat.

IMMUNITY.

The subject of immunity and immunization is of so much interest to swine breeders that the addition of a special article setting forth the basic principles seems to be demanded.

Immunity is the power of resistance which every form of life posses against injury or destruction by some other form. The term is used almost wholly in the sense of expressing a resistance of an individual to disease. It is an inherent quality in all animal or plant life. It varies in the different species toward the same cause and in individuals of the same species toward different causes. The term is no longer applied to the resistance of the individul to some organism, but is made to include the products or toxines produced by the organism. Immunization is the process by which the resistance may be increased towards any particular form of organism.

The difference in immunity in the different species towards the same cause is easily illustrated by a comparison of the diseasess occuring in the human subject and in the lower animals. In the human, we have cholera, typhoid, and yellow fever, that are never found in other species. The lower animals therefore possess a very high degree of immunity toward these diseases. In swine, we have swine plague that never occurs in the human. In cattle, we have southern cattle fever that does not effect any other species. We have other diseases as tuberculosis and glanders that may effect the human and some of the lower forms. There are some

diseases of the human that have not been successfully inoculated into the lower animals and likewise diseases of one specie that do not occur in another. An individual or a specie may have a very strong natural immunity against a given form, but by exposure under adverse conditions or by inoculation, my become affected.

Immunity is therefore only a relative term and is not absolute. It is said to be strong or weak as measured by the degree of resistance under ordinary conditions.

Age is an important factor in natural immunity. The young as a rule offer a lesser degree of resistance to infectious diseases than do the old, while the latter show a greater susceptibility to chronic affections. This can probably be best illustrated from examples in the human subject. Children are prone to have measles, scarlet fever, chicken pox, "mumps," and these are commonly known as children's diseases. A person may contract one of these diseases when they have arrived at maturity but the chances of doing so are very greatly reduced. This is often ascribed to the fact that most persons have these troubles when young and therefore are protected against a second attack. The fact remains, however, that among persons who have escaped these diseases while young, the power to resist an attack is greater than in the average child. To draw a like illustration from the lower animals, we may cite the fact that sore mouth and joint diseases occur in very young pigs, cholera principally among the young, and pigs that are half grown, while swine plague attacks half grown and older animals. It is not meant to convey the impression that these diseases may not occur at any age but the large preponderance of all cases do occur at the time indicated, and that there is a difference in resistive power at different ages independent of the effect of previous attacks.

Effect of previous attacks.—Immunity results from an attack of some diseases. We can divide diseases into two classes upon this basis, those which do not tend to occur after one attack and those in which the tendency is but little or not at all diminished. In the diseases of the first class there are changes which take place in the body that protect it for a greater or less length of time, and in some, as long as the subject lives. In the second class these changes are so slight that they have only a temporary if any effect. The immunity thus acquired is not necessarily due

to changes caused by the presence of the disease germs but may be due to the products which they produce. The products of the disease germs are called toxines. That the immunity which results from an attack of some diseases is due to these poisons and not to the presence of the germs can be easily demonstrated. The germs may be grown in a suitable medium, as boullion, and after they have grown some time the material may be filtered and heated so there will be no living germs present. This material will contain the toxine or poison produced by the germ, and if injected into the body of a suceptable patient, first in small, and then gradually increasing doses it will be found that the patient will acquire immunity the same as that following an attack in the usual way. In this instance there has been no disease germs and yet immunity results. The body has formed the same protective products to neutralize the poison introduced artificially as would have occurred if they had resulted from the growth of the germs in the body. In the second class of diseases there are no protective products formed, or if there are, they are too weak to be effective.

It must also be borne in mind that different diseases attack the body in different ways and that the protective powers also differ. Some produce their effect through a poison or toxine as already cited, and the resistance comes from the antitoxine formed. The two best known and most thoroughly studied diseases of this type are diphtheria, and tetanus or lockjaw. Both the toxine and antitoxine are so well known that the latter is extensively used in the protection and cure, especially for diphtheria. Some diseases affect the body through the enormous multiplication of the germs. In this type there may be a product formed which tends to arrest this multiplication, or there may be special destructive activity on the part of certain cells, especially the white blood corpuscels. The product which tends to prevent multiplication is known as a bacteriolysin. Bacteriolytic products are not so well known as antitoxines and not so successful in use. That most employed in medicine is antistreptococcus serum in the treatment of blood poisoning.

The immunity gained as the result of an attack of a disease, whether it be antitoxic, bacteryolitic or both, is a natural acquired immunity.

In the case of hog cholera we do know that a certain amount of immunity is acquired. A brood sow that has successfully withstood an at-

tack of disease has an enhanced value because of the fact. The immunity which she has acquired is not transmitted to her offspring. It is an exceedingly desirable quality to be obtained in all, occurs in nature in so few, and at such great price that every known artificial method has been employed to induce it. These will now be considered in some detail.

Vaccination.—Since immunity results from an attack of some diseases and the immunity gained from a mild attack is protective the same as for a severe attack, attempts have been made to induce a mild form for protection. This was first done in connection with small-pox. The patient was dieted and put in as healthy condition as possible and then virus was taken directly from an afflicted patient, care being exercised to select one suffering from a mild form of disease. This had the desired result in many cases but often caused death. Virus taken from a mild case might suddenly acquire increased virulence with fatal results. Later, it was discovered that patients vaccinated with cow-pox in a natural way in handling cattle were immune to smallpox, or that those suffering from the cow-pox had it in a very mild form compared with those vaccinated with small-pox. This led to the abandonment of the human virus and the substitution of the bovine material or cow-pox. Sepsis and other serious complications often resulted at first but the method of preparing the virus, preserving, and using it, have been so greatly improved that it is now used with a feeling of safety. We now know that the cow-pox and small-pox are the same diseases, but the passage of the disease through the cow reduces its virulence for the human subject. Furthermore we know the immunity gained by the bovine virus is not so strong or so enduring as that from the human. The operation of vaccination consists of abrading or scratching the surface of the skin and rubbing in the virus. Vaccination has been tried for the prevention of hog-cholera and swine plague but without the degree of success that is essential in practice. The virus taken from infected hogs is not so satisfactory, and there is no other animal known to have the disease so that it may be modified by passage through a different body. Attempts to modify the virus by artificial means has also been a failure.

Innoculation.—Immunity may also be acquired by artificial means by a method popularly known as innoculation. In this method the virulence of the germs are reduced by artificial means. It has its best application

in the prevention of blackleg. The tissues of an animal having died of blackleg are heated to such a degree as to nearly destroy all germs. A bit of tissue is then rubbed up with some sterile water, filtered and injected into a susceptable animal. The innoculation has the effect of producing a mild form of the disease which will suffice to protect against a natural infection. In localities where the danger is great, an innoculation is first made with material that has been heated to a high degree, and after ten days again innoculated with material that has been heated to a lesser degree, but which if used in the first case would cause serious illness and possibly death in many cases. The first inoculation produces a slight immunity and the second greatly increases it.

Heating is not the only method of decreasing or attenuating the virulence of germs. It may also be accomplished by growing them in different media, and at different temperatures for different periods of time, and by chemicals. All of these methods have been employed in securing a virus for protecting against hog cholera, and like vaccination, without success except in a comparatively limited number of cases. Both vaccination and innoculation are objectionable in that living germs are employed and in the event mild cases are induced the germs will be passed from the body, and may become the center of infection for an epidemic in a herd or neighborhood.

Inoculation differs from vaccination in that the material is placed directly into the tissue of the body with a hypodermic syringe and not by scratching the surface.

Inoculation is also made by taking blood from an animal suffering with the disease and injecting it into a susceptible animal. This is the method used in immunizing against southern cattle fever. The dose is small. Attempts have been made to use the sterile serum from affected animals but without success. In the case of southern fever the hypodermic syringe takes the place of the tick, which does the same thing under natural conditions. By the artificial method the size of the dose is regulated. The same method has been tried with hog cholera.

Feeding.—Immunity may also be acquired by feeding small quantities of germs that have had their virulence reduced. The quantity and virulence are both gradually increased until the animal can successfully withstand what would ordinarily produce a serious or fatal illness. This

method has been found successful in some experimental work and is used by a few breeders with apparent success. This is in reality at the basis of a method that has received a great deal of attention in the past few years. It was accomplished in a crude way by feeding swine on pieces of the carcass of one that had died of cholera. The quantity was gradually increased and the period between the feedings shortened. The animals selected for the purpose were generally old ones whose resistance were already strong. Its use was especially recommended for breeding sows near the time of farrowing, as it was believed that immunity would result in utero. The process was continued after farrowing to intensify the immunity through the effect on the mother's milk. The natural product not being always available and necessarily of variable character, cultures of the germs were soon substituted. As the practical application of this method is conducted on a commercial or trade basis, little is known of the uniformity of the virulence of the germs. It is even more objectionable than vaccination or inoculation in that there is sure to be infection of the premises, and the possibility of making a center for an epidemic. The principle involved in this method is not a new one, it is only the application in a commercial way and the extensive advertising that has attracted attention.

Dead Cultures.—It has been found in the course of many experiments with disease germs that immunity may be acquired in some cases after the injection of dead germs. For this purpose, the germs are usually grown upon some solid media like agar agar, and when they have made a good growth, they are scraped off, dried and killed at as low temperature as possible. The germs are then macerated in sterile water and injected as in inoculation. This has been tried in almost every conceivable way, using all known, and I might say, almost all unknown media and at different temperatures. The material prepared after this manner is frequently called antitoxin and used for immunizing purposes. It is not a true antitoxin and does not cure nor prevent in the same way as antitoxin. There is probably some merit in the method the same as may be said for all. It has not been perfected to such a degree that it can be recommended.

In all the foregoing methods the object has been to develop in the body a substance or substances, that will act as a protective agent for a

considerable period of time. The object sought has been to produce such a mild form of the disease that a second attack will not occur even though an epidemic be present in the community. The immunity that would thus be acquired would be active. There still remains two other methods of securing immunity.

Antitoxin.—In some diseases, the marked effects upon the body are due to the poison which the germs produce and not to the number of germs present. This is notably true of diphtheria and tetanus. After both of these diseases, we find that the blood of the patient contains a substance known as antitoxin and has the power of neutralizing the toxine produced by the bacteria. This substance is so strong that blood may be taken from such a patient, and if the serum be injected into the body of a patient exposed to the disease, or found to be diseased, it will prevent or greatly lessen the severity of the attack. We take advantage of this fact, and use the antitoxin in a very large percentage of cases with better results than any other known treatment. In making antitoxin for the treatment of diphtheria, the horse is selected for providing the serum. A healthy animal is inoculated with a small dose of the toxine and as soon as it makes a recovery, a little larger dose is given. This is repeated at short intervals for a period of from six to eight weeks. At the end of this period the animal will be able to stand a dose a hundred or more times greater than would have been tolerated at the first inoculation. The blood of such an animal will possess an enormous mimunizing power. When used upon the patient however, it simply adds that property to the blood and does not cause its development in the body. The immunity conferred only lasts for a short time, from four to eight weeks, or long enough to pass over a period of infection. A similar line of work has been done in connection with hog cholera and swine plague. The results have been interesting from a scientific standpoint rather than the practical. The cost in developing the serum, the care needed in its application, and the short period of immunity conferred have all been against it. It was used in the government experiments, but only a few firms ventured into the production upon a commercial scale, and none are in operation as far as known to the writer.

Toxine Method.—In this method the germs of the disease are grown in a suitable media like beef boullion, and when they have produced about

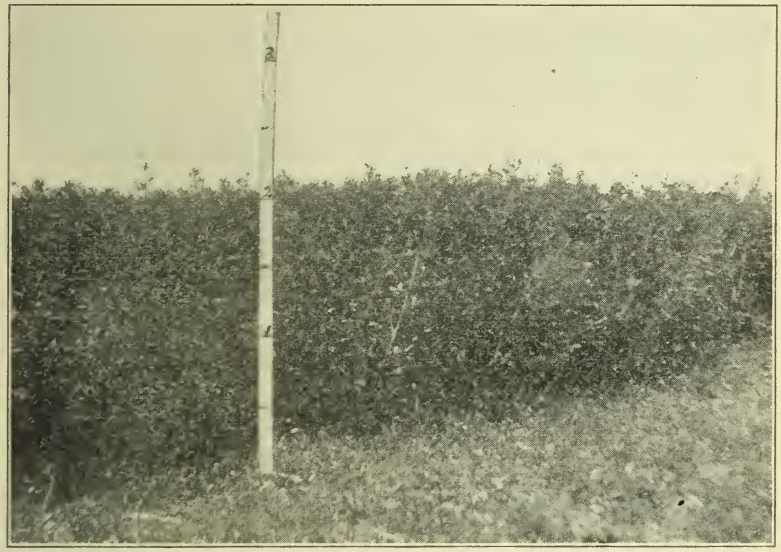
all the poison they will, they are then filtered off and the poison is injected, first in a small and then in a large dose thus stimulating the body to produce its own antitoxin. This is the method used in developing a strong antitoxin in the horse's blood aginst diphtheria, but it is not practical in its application to the treatment of millions of hogs on the farm.

Antibactericidal sera.—A bacteriolytic serum is used in the treatment of septicaema or blood poisoning. This serum has the effect of greatly increasing the destructive powers of the normal serum of the blood. This acts differently from the antitoxin. Instead of being direct, its effects are indirect. Theoretically it would seem that such a serum would be indicated rather than an antitoxine. Experimentally however, the proper or effective serum has not been found.

We are familiar with the results obtained by several veterinarians with the use of the different antitoxines upon the market, and they have not been of such encouraging character as to warrant their general use. There are firms that use purely chemically compounded preparations under the name of antitoxine, but as they are misnomers and intended to mislead. They have no place in this discussion.

Purdue University

Agricultural Experiment Station



BULLETIN NO. 101. VOL. XII.
FEBRUARY, 1905.

Alfalfa in Indiana.

Published by the Station:
LAFAYETTE, INDIANA,
U. S. A.

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ALFALFA IN INDIANA

By A. T. Wiancko and M. L. Fisher.

INTRODUCTION.

During the last few years a widespread and increasing interest in alfalfa culture has sprung up in Indiana. Hundreds of inquiries have come to this station, showing that farmers in all parts of the state are seriously thinking of trying the crop. The questions asked are generally quite comprehensive and concern its general characteristics, its adaptation to certain local conditions, its feeding value, methods of seeding, inoculation, later treatment, etc.

To meet this demand for knowledge about alfalfa an investigation was begun in the spring of 1903 with a view to ascertaining the suitability of the soil and climatic conditions of Indiana for the profitable production of the crop. With the cooperation of students of the School of Agriculture and other interested farmers a number of experimental plots were established in every section of the state under widely differing conditions. In each case different methods of seeding, with and without inoculation, were tried and much other valuable information about its production in the state has been collected. The results of these investigations prove beyond a reasonable doubt that alfalfa deserves a place in Indiana agriculture.

The object of this bulletin is to make known to our farmers what has been learned about the culture of the crop in the state, and to assist those who wish to use it.

HISTORY.

Alfalfa is one of the oldest of cultivated forage plants. It was used by the Egyptians, Greeks, Romans and other nations of the East long before the beginning of the Christian era. It is a native of the southern and western portions of Asia, thriving particularly well in the higher and drier regions. It was early introduced into

Spain and the Spaniards carried it into South America and Mexico. Its introduction into the United States dates as far back as 1820, when it was tried in New York state. It was brought from Chili to California about fifty years ago and now flourishes throughout the arid and semi-arid west as perhaps in no other region of the world. On account of its hardy, drought-resistant qualities it is particularly well adapted to high, dry regions. From California it rapidly spread eastward and is now grown in almost every state and territory in the Union. Its high feeding value, great yielding power and adaptation to widely varying soil and climatic conditions have made it deservedly popular wherever it has been grown.

DESCRIPTION AND GENERAL CHARACTERISTICS.

Alfalfa (*Medicago sativa*) is a member of the family botanically known as the Leguminosae, to which also belong the clovers, peas, beans, vetches and other plants with pea-like blossoms and podded fruits. It is an upright, branching, smooth, perennial plant, growing from one to three feet in height. Its stems are somewhat coarser in appearance than those of red clover. The young plant sends up a single main stem. When this is cut off and the plant grows older, more and more stems shoot up from near the ground. In old plants that have been cut off many times the stems become very numerous, sometimes as many as a hundred springing from a single crown. The leaves are three parted, somewhat longer and much narrower than those of red clover and are somewhat toothed around the apex. They are much more numerous than on red clover and are very nutritious. The whole plant has a characteristic deep green color when in a healthy condition, especially in a dry season.

The small pea-like flowers are purplish to pinkish in color and are borne in loose clusters or racemes along the smaller stems and branches. The ripe seed-pods are spirally twisted, forming two or three complete curves, and each pod contains several seeds. The seeds are kidney shaped, yellowish brown in color, and about a half larger than red clover seeds.

Like all members of the clover family, alfalfa has a strong tap root which it sends deeply into the soil. These roots sometimes exceed an inch in diameter, and in open soils often extend downwards

to a depth of fifteen to twenty feet, and much greater depths have been recorded. The great power of alfalfa roots to penetrate hard soils is well illustrated on the experimental farm here at LaFayette, where roots have been dug up which penetrated through a foot and a half of hardpan, composed of fine silt and gravel, which could hardly be broken up with a pick. As the root extends downwards, numerous fine, lateral roots are produced, completely filling the soil and extending the feeding area to immense proportions. This enormous development of roots, and the great depth to which they penetrate, enables the plant to gather food and moisture from depths not reached by ordinary plants. Much mineral food is thus brought to the surface and the roots, when they decay, leave the soil full of small, tube-like channels which facilitate drainage and the aeration of the soil, a benefit which may be very considerable in close textured soils.

Alfalfa, like the clovers, has the power of assimilating the free nitrogen of the atmosphere through the agency of bacteria which develop numerous small nodules, or tubercles on its roots. These nodules contain millions of bacteria which live on the juices of the root and in the process of their development supply the plant with available forms of nitrogen which they have the power to form from the practically unlimited supply in the air. This gives the plant a very important additional value as a farm crop, since it enriches the soil with large quantities of available nitrogen for the use of succeeding crops. Thus, where alfalfa is grown it will be necessary to supply the soil with only mineral plant food; the alfalfa and its bacteria will look after and increase the nitrogen supply.

Alfalfa, by reason of the large crops produced, draws heavily upon the mineral plant food in the soil, using large quantities of potash, lime and phosphoric acid. It is true that by means of its deep roots it obtains food from depths not reached by other crops, but it must be remembered that in humid regions the subsoils often contain comparatively little available food and that, therefore, even so deep rooted a crop as alfalfa may not be able indefinitely to secure all the mineral plant food necessary for its best development. As a matter of fact it will generally respond well to liberal applications of mineral fertilizers, and where long grown it will often be

necessary to supply it with potash, phosphoric acid and lime. Except on limestone soils, a moderate application of air-slaked lime at the time the seed-bed is being prepared, will generally be very beneficial.

FEEDING VALUE OF ALFALFA.

As a food for all kinds of live stock alfalfa is the king of forage crops. It is especially rich in protein, or flesh forming material, and is well adapted for use in a ration with corn which is relatively low in protein content. It makes excellent hay and is more digestible than most forms of rough feed. As a pasture and soiling crop it has few, if any, equals and one of the qualities which recommend it most highly is its rapid growth. For soiling purposes it can be cut four or five times in a season and for hay it will usually yield three good crops in Indiana, and sometimes four. As a pasture for hogs it is unexcelled. It helps to keep the animals in a healthy condition. Hogs running on good alfalfa pastue are much less liable to cholera and other germ diseases. It also makes excellent pasture for cattle, sheep and horses. In pasturing ruminating animals on alfalfa it is, of course, necessary to take the same precautions to prevent bloating as are necessary when pasturing clover.

TABLE SHOWING TOTAL DRY MATTER AND DIGESTIBLE NUTRIENTS IN 100 POUNDS OF ALFALFA, RED CLOVER, TIMOTHY, WHEAT BRAN AND CORN.*

Feeds	Total Dry Matter	Digestible Protein	Digestible Car'hydrates	Digestible Fat
Alfalfa	91.6	11.0	39.6	1.2
Red Clover.....	84.7	6.8	35.8	1.7
Timothy	86.8	2.8	43.4	1.4
Wheat Bran	87.7	12.3	37.1	2.6
Corn (grain)	89.4	7.8	66.7	4.3

*Compiled from Henry's "Feeds and Feeding."

SUMMARY OF RESULTS OF EXPERIMENTS.

In the spring of 1903 twenty-three experimental plots were established in as many different counties of the state. The soil ranged from heavy clay to light sandy loam. In each case the alfalfa was

sown with and without a nurse crop. The nurse crops consisted of light seedings of oats or barley. Each plot occupied one quarter of an acre and all were inoculated with soil from old alfalfa fields which contained the alfalfa bacteria. The soil was applied broadcast at the rate of 100 pounds of dry soil per acre. The alfalfa seed was sown at the rate of 20 pounds per acre. The seeding was done at different times, the dates ranging from April 10 to June 15. Of 18 satisfactory reports secured in the following autumn, 11 showed good condition, 6 fair and 1 rather poor condition. Seven reported best stand without a nurse crop, four with a nurse crop and six reported no difference. Of those reporting *fair* condition, five reported damage done by dry weather shortly after the crop came up. Of those reporting *good* condition, seven reported nodules on the roots, one none, and three did not examine the roots. Of the second group, four reported some nodules, two found no nodules and one was doubtful. The one reporting *poor* condition found no nodules on the roots.

In the spring of 1904 nine additional plots were established in other sections. The general plan of the experiments was the same as in 1903, except that only one-half of each plot was inoculated, and in such a way that each plot was virtually divided into quarters, one having alfalfa, nurse crop and bacteria, another alfalfa and nurse crop, another alfalfa and bacteria and the fourth only alfalfa. The object of this plan was to determine not only the advisability of using a nurse crop but also the necessity of inoculation.

SUMMARY OF ALFALFA EXPERIMENTS.

COUNTY	Kind of Soil	Kind of Subsoil	Depth to Standing Water	Date of Sowing	Stand with Nurse Crop	Stand without Nurse Crop	Fall Condition	
							Inoculated Plat	Uninoculated Plat
1903								
Lake	Sandy	Rather compact	15 to 20 ft.	May 12	good	good	good	good
Benton	Loamy	Open	12 feet	Apr. 10	good	good	good	good
Marshall	Sandy	Gravel	8 feet	Apr. 23	good	good	good	fair
Marshall	Clay loam	Compact	4 feet	Apr. 28	good	good	good	poor
Tipton	Clay&black loam	Clay	4 feet	May 20	good	fair	good	good
Wells	Clay&black loam	Clay	4 feet	June 15	good	good	no inoculation	good
Madison	Sandy loam	Rather compact	15 feet	Apr. 15	fair	good	good	fair
Delaware	Clay	Clay	10 feet	Apr. 25	fair	good	fair	fair
Fayette	Clay loam	Clay	15 feet	May 27	good	good	good	good
Morgan	Sandy	Open	30 feet	Apr. 10	poor	good	no inoculation	good
Barthol'm'w	Clay	Red Clay	20 feet	Apr. 27	good	good	fair	all inoculated
Johnson	Sandy	Open	8 feet	Early	good	.....	no inoculation	good
Greene	Clay	Compact	.. ..	May 25	fair	good	fair	fair
Knox	Clay	Yellow Clay	10 to 20 ft.	Apr. 28	good	fair	fair	poor
Daviess	Yellow clay	Yellow Clay	4 feet	May 23	fair	good	fair	poor
Pike	Sandy	Compact	20 feet	Apr. 30	fair	good	fair	all inoculated
Washingt'n	Loam	Clay	60 feet	May 1	fair	good	fair	fair
Perry	Clay loam	Clay	10 feet	Apr. 29	good	fair	good	fair
1904								
Marshall	Clay loam	Compact	10 feet	Apr. 22	good	good	good	good
White	Black loam	Clay	5 feet	May 27	good	fair	good	good
Miami	Sandy	Open	4 to 6 ft.	June 13	.....	fair	fair	.....
Montgom'ry	Sandy clay	Open	3 to 4 ft.	.....	good	good	fair	fair
Fayette	Sandy loam	Open	5 feet	late	fair	fair	fair	fair
Wayne	Sandy clay	Gravel	6 to 8 ft.	May 15	fair	fair	fair	fair
Knox	Clay	Compact	10 feet	Apr. 22	poor	fair	fair	fair

The results of the experiments as a whole indicate that good stands of alfalfa may be secured on almost any of the soils of the state, though the more open soils seem to be preferable. They also indicate that inoculation of the soil is desirable and, in most cases, necessary. As to the best time to sow alfalfa, the experiments are inconclusive unless they be taken to indicate that a good stand can be secured at almost any time from early April to June. The experiments also seem to indicate that there is still room for argument as to whether or not a nurse-crop should be used, though on the whole the chances seem in favor of sowing the alfalfa alone.

SUMMARY OF OTHER REPORTS.

In addition to the results of the experiments under the direction of the station, a number of valuable reports from farmers growing alfalfa in various parts of the state were secured. Report blanks with numerous questions were sent out to all growers of the crop in the state who could be located and 38 complete reports were received. Of these, 32 reported the crop a success. Of the failures reported, two were attributed to lack of inoculation, one to winter-killing, one to careless pasturing, one to poor drainage and one to drougth after seeding. In reply to the question, What are the causes of failure? fourteen replied, weeds; six, no inoculation; eight, poor drainage; four, early pasturing; and three, drought after seeding. Good stands were reported on all kinds of soils, from light sands to the heaviest clays. In the majority of cases the seeding was done in April or early in May. About sixty-five per cent of the fields were seeded without a nurse crop. The treatment during the first season was in nearly all cases clipping at intervals to check weed growth. Only two growers gave their fields any treatment, except mowing, after the first season. In one case discing is practiced in spring and early fall and in the other after each cutting for hay, when the ground is dry. Both these farmers are extensive and very successful growers of alfalfa. In the majority of the cases reported the number of cuttings, per season, for hay is three and the average yield of dry hay per season is three and one-half to four tons, while three of the largest growers report averages of about five tons per season. In all cases, except one, where pasturing was practiced satisfactory results were reported.

The reports summarized above cover an aggregate of 260 acres of alfalfa, standing at the time the reports were made, and the great majority of the growers expressed themselves as highly satisfied with the crop.

SOIL AND SITUATION FOR ALFALFA.

The beginner in alfalfa culture should be careful to select a piece of ground that is well suited as a home for the crop. It will do best on deep loams with rather open subsoils and deep, natural drainage. Numerous reports show that good results can be secured on almost any fertile soil, provided that it has good drainage. Where natural drainage is imperfect, deep, artificial underdrainage may, to a large extent, take its place. Good drainage is absolutely necessary for alfalfa, because, for its best development, the roots must be permitted to penetrate deeply into the soil. It will not thrive with its roots in standing water. Lands subject to overflow are unfit for alfalfa. As a rule alfalfa should never be put on low bottom lands where grasses naturally do well, because the situation is likely to be too wet. High situations are therefore preferable. The only high lands not suited to alfalfa are those having either a hardpan or a very gravelly subsoil.

Alfalfa does not reach its best development until three or more years old. For this reason the situation selected for its growth should be one in which it can be left for a number of years. For the same reason the crop is not suited to an ordinary rotation.

SEEDING.

The soil for alfalfa must be free of weed seeds, and a fine, deep seedbed must be provided. Alfalfa plants while young are delicate and easily smothered by weeds. Clean culture is therefore necessary. The seeds are small and must have a fine seed-bed in order that germination and early growth may be facilitated. Since the crop is to remain in the same situation for a number of years it will pay well to give careful attention to the preparation of the soil. A full stand of plants is essential and to secure that, as well as a strong early growth, a good seed-bed is necessary. This point cannot be too strongly emphasized. A good seed-bed can usually be prepared

after corn or some other cultivated crop that has been kept clean.

The time of seeding alfalfa does not seem to be very important so long as there is sufficient moisture to give the plants a good start. Usually, however, it will be best to sow some time before corn planting in order that the plants may develop a good root system before dry weather begins. After it is once well established the crop can stand very severe droughts.

The seed may be sown either alone or with about a half seeding of oats or beardless barley. Where the ground is free of weed seeds it will usually be best to sow alone, but where weeds are likely to be troublesome a nurse-crop should be used. In either case about 20 pounds of good seed per acre should be used. The seed may be sown broadcast and covered with a light harrow. If a nurse-crop is used this may be drilled in the ordinary way and the alfalfa sown on top and lightly covered with a harrow or weeder.

The nurse-crop should be cut for hay soon after it heads out so as to give the alfalfa full possession of the soil before the hot weather sets in. If the nurse-crop is allowed to mature the alfalfa will be shaded too long and will not develop sufficient strength to bear the sudden exposure to hot weather. In several instances successful stands of alfalfa have been secured by sowing in standing corn at the time of the last cultivation.

INOCULATION.

Alfalfa, like all other legumes, requires for its proper development a certain species of bacteria to work upon its roots and gather for it nitrogen from the atmosphere. If these bacteria are not present, the alfalfa will have to depend for its nitrogen upon the supply in the soil which is usually not sufficient to insure a thrifty growth. In nearly all cases where alfalfa is grown for the first time inoculation is necessary and should not be neglected. This inoculation may be effected by means of soil from an old alfalfa field where the bacteria are known to exist or by treating the seed, shortly before sowing, with a pure culture of the alfalfa bacteria. If alfalfa soil is used, at least 100 pounds per acre should be applied. Larger quantities will give quicker results. It may be sown by hand while the seedbed is being prepared, or at the time of seeding. On soils not rich

in nitrogen a dressing of farmyard manure will give excellent results in giving the alfalfa a vigorous start until the bacteria become established.

TREATMENT OF THE GROWING CROP.

If the alfalfa has been sown alone the field sould be clipped with a mower as soon as the plants are about six inches high. This clipping is necessary, not only to check weed growth, but to strengthen the young alfalfa plants. The clipping causes the plants to branch out and grow with renewed vigor. This treatment should be repeated several times during the summer. Every clipping will strengthen the growth and it should in no case be neglected, because neglect may mean failure.

Where a nurse-crop is used this should be made into hay at the proper stage and the clipping continued at intervals as in the case were no nurse-crop is used. The clippings should generally be left on the ground.

After the first season the alfalfa, unless it is used as a pasture, should be cut for hay every time about one-tenth of the heads are in bloom. After each cutting, if the ground is dry, it will usually be well to go over the field with a disc harrow. This is practiced by some of the best growers with excellent results. The discing splits the crowns and strengthens the growth. The disc must be set at a small angle so as not to cut off or tear out the plants. By some this discing is done in two directions, crossing each other at right angles.

MAKING ALFALFA HAY.

To secure the largest amount of digestible nutrients per acre, alfalfa for hay should be cut when one-tenth, or at the most one-fifth, of the blossoms have opened. Where much is to be cut it is well to begin early, because, as it gets older, alfalfa deteriorates very rapidly in feeding value. Many analyses and feeding experiments have been made by the experiment stations and all show that to get the best results alfalfa must be cut at a very much earlier stage of development than red clover. To begin cutting when one-tenth of the heads are in bloom is a good rule to follow. Late cut-

ting not only means a poor quality of hay but is also detrimental to the development of the next cutting, so that early cutting should be pacticed regardless of the weather.

During the curing process alfalfa must be carefully handled, because the leaves soon dry and are then easily broken off. The leaves are more valuable, pound for pound, than good wheat bran, and rough handling when dry may very much lessen the value of the hay. It should never be handled when perfectly dry. As a rule it is wise to use a tedder a few hours after mowing, or as soon as it is well wilted on the surface, and to rake it into loose wind-rows as soon as the rake will handle it. If the weather is good it may be cured in the wind-row, but often it will be best to cure it in small high cocks. All subsequent handling when hauling to the barn or stack should be done while it is slightly moist with dew so that the loss of leaves may be reduced to a minimum. Rain injures alfalfa even more than it does clover. When placed in stacks, which should be done only when unavoidable, these should be topped with timothy hay or other material that will shed rain. As a rule alfalfa hay is somewhat more difficult to make and cure properly than is clover, but, in general, it may be said that the same methods will apply to both crops.

PASTURING ALFALFA.

As a rule alfalfa should not be pastured the first season, and but lightly the second. At no time should it be pastured closely. By close pasturing the crowns of the plants are injured. Horses and sheep are more likely to do damage in this way than are cattle or hogs. On account of injury to the crowns from tramping, it should not be pastured when the ground is soft. As has been already stated, alfalfa makes excellent pasture for all kinds of live stock, being very nutritious and healthful. With cattle and sheep care must be taken to avoid bloating. The animals, at first, sould be turned in for only a short time each day until they become accustomed to it, and when the alfalfa is wet, as after a rain, there is still greater need of care. It is wise to be a little more careful than with clover.

SUMMARY AND CONCLUSIONS.

Good crops of alfalfa can be grown on almost all Indiana soils that have good, deep drainage. Water must never stand on or near the surface.

It will yield from 3 to 5 tons of excellent hay per acre per season, and for soiling or pasture it has few equals.

It is rich in flesh forming nutrients and is excellent for feeding with corn or other starchy foods.

It is more digestible than red clover and is not far behind wheat bran in feeding value.

It is an excellent soil renovator, gathering nitrogen from the air, opening up the soil and bringing large quantities of mineral food from the subsoil.

It may be sown at any time from early spring to midsummer, provided there is sufficient moisture to give it a good start, but rather early sowing seems preferable.

The seed-bed must be deep and finely prepared and about 20 pounds of good seed per acre should be used. The seed should be lightly covered with a harrow or weeder.

It may be sown either with or without a nurse-crop. The nurse-crop is to be recommended where weeds are likely to be troublesome, but it should in all cases be cut for hay soon after it heads out. A half seeding of oats or beardless barley makes a good nurse crop.

Inoculation will be necessary in nearly all cases and should not be neglected.

A good dressing of farmyard manure will aid materially in securing a good stand and vigorous growth. It will also facilitate the inoculating process.

During the first season the growth should be cut down every time it reaches a height of five or six inches. Where a nurse crop is used this treatment should also be practiced after the latter has been removed.

If the crop is grown for hay it should be cut every time about one-tenth of the blooms have appeared. It is generally not wise to try to get a hay crop the first season.

Alfalfa should not be pastured the first season and never closely. When cattle or sheep are pastured on it, care must be taken to prevent bloating.

Cultivation with a disc harrow, set shallow, after cutting in July and August, if the soil is dry, is likely to be beneficial.

Purdue University

Agricultural Experiment Station

Bulletin No. 102. Vol. XII.
March, 1905.

Apple Growing in Indiana.

Published by the Station:
LAFAYETTE, INDIANA,
U. S. A.

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Apple Growing in Indiana.

By J. TROOP

A half century or more ago it was not considered a difficult matter to grow apples to perfection in Indiana. Indeed the fathers of the present generation delight in telling how much better the apples were when they were boys than they are now, that the trees were longer lived then than now; that there were few, if any, insects or diseases then, to bother the fruit or trees; and, indeed, an occasional old orchard or parts of it, with trees thirty to forty feet high and two feet or more in diameter, which we sometimes find in certain favored localities, would seem to bear testimony to the truth of the statement. And yet we must remember that tastes have changed very much since these men were boys, and that the favorable conditions which existed then are no longer to be found. With the destruction of the forests which originally covered the greater portion of our state, and the natural vegetation which covered the soil both in swamps, marshes and on upland, we have destroyed the natural food-plants of miriads of insects,and the nesting places of thousands upon thousands of insect-eating birds. Not only this, but great numbers of other insectivorous animals of various kinds have been destroyed by this same process of subduing the land and rendering it suitable for cultivation. By this process the climate has become not only more severe, but much more erratic than formerly. Then, too, we no longer have the virgin soil, already rich in all the elements that go to produce both tree and fruit to perfection, but one that in many cases, has been cropped until it has become practically exhausted. So then we no longer meet with the same conditions that our forefathers enjoyed. The trees are surrounded by entirely different environments, and so the fruit-growers of today have an entirely different problem to solve from that which confronted them. Seventy-five years ago science had very little to do with the raising of fruit; today nothing is undertaken by the

progressive fruit grower, without first asking why? From the selection of the site, through all the various processes of planting, cultivating, pruning, thinning, harvesting, etc., until the apples finally reach the customer, after spending from three to six months in cold storage, science plays a very important part. So, then, the successful fruit grower of the future must take science as an active partner in the business, because it will tell him *why* it is necessary to do many things now that were not necessary in the early days of fruit growing in this country.

It is not, however, the aim of this bulletin to discuss the technical, scientific questions which enter into the subject of apple culture to any great extent, but rather to place the necessary information concerning the production of an apple orchard, in such a comprehensive form as to enable us to answer the many questions which are constantly coming to us from those who are contemplating planting an orchard in the near future. This in itself is an evidence of the fact that such information is needed. New truths are constantly being discovered by those who are making a life study of the problems presented, and new generations of fruit growers are constantly coming on, who must learn these truths either by their own experience or from the experience of others. The latter, if not the most satisfactory method, is at least the method which is most likely to yield immediate results. And so it is with a hope of stimulating the younger generation in particular, to greater activity along this line that the following pages are written.

It may be well to state here that our cultivated apple is not a native of this country, but, like most of our orchard fruits, was brought to this country by the early settlers, from Europe and Asia, where the process of cultivation and improvement has been going on for thousands of years. Our cultivated varieties of today then, are the product of centuries of horticultural skill in selection, cross-pollination and hybridization. In fact this process has been carried on to such an extent that it would be next to an impossibility for any one to trace, with any degree of accuracy, the pedigree of any of our cultivated varieties. When we come to understand the many different strains of blood which enter into its constitution it does not seem so strange that it

should have its likes and dislikes as regards soil and climatic conditions. And yet, like the strawberry, it has a wonderful power of adapting itself to different environments, thus making it one of the most valuable fruits grown in this climate.

Adaptability of Soil and Climate.—In Indiana as well as in every other State in the Union, there are localities which are naturally adapted to fruit growing, while other portions are better adapted to the growing of grain and hay. This may be due either to climatic influences or to the character of the soil or both. In this case both of these factors play an important part, but, generally speaking, Indiana is essentially an apple growing state. It is true that the state is not so favarably situated as is Michigan in having a large body of water situated so as to very materially influence the temperature for a considerable distance along its borders, only a small portion of Indiana being thus protected. But with the same care and attention, the same varieties which are grown in Michigan may be successfully grown in Indiana. It is a notable fact that the section of Northern Indiana, where the soil conditions are best adapted for fruit growing, is to a certain extent, under the ameliorating influence of Lake Michigan, so that there is practically no difference between Michigan and Northwestern Indiana, when judged from a horticultural standpoint. The northwestern portion of the state, however, was not intended by nature for commerical fruit growing. Here both soil and climatic conditions are better adapted to the growing of other crops which are less sensitive to the variations of temperature. This section of the state is for the most part too flat for orchard purposes, but is especially adapted to crops grown by the market gardener, the dairyman, and beef raiser. And yet even in this section there are many localities where, with a little protection in the way of a light screen of forest trees, the farmer is able to supply his family with all the apples needed, and have some to spare.

Good orchard lands may be found in every county comprising the central portion of the state, although there are exceptional localities where the surface is too flat, and where the land is better adapted to other purposes. Although a hundred miles farther south, the mean annual temperature is about the same at La-

Fayette as it is at LaPorte, which is due in a large degree to the influence of the lake in modifying the climate at the latter point.

In the southern portion of the state the mean annual temperature is about ten degrees warmer than that of the northern end. With other favorable conditions, such as soil, protection from severe winds, and perfect atmospheric drainage, owing to the fact that the country is for the most part quite rolling, nature seems to have intended the greater part of it for fruit growing. Here the soil is for the most part decidedly different from that found farther north. In a report of the United States Geological Survey, made some years ago, mention is made of the "White Clay lands," which cover a large portion of Southern Indiana, Ohio and Illinois, where most of the finest apples are grown. In Indiana the northern boundary of this peculiar formation, ac-

FIG. 1. View in an Indiana orchard that yields from one hundred to one hundred and fifty dollars an acre annually.

cording to the description, begins near Terre Haute on the west and passes more or less irregularly across the state, passing into Ohio near Brookville, Franklin county. Thus the greater portion of the state south of this line is made up of this white clay deposit. In many places this clay becomes almost a brick-red, but the characteristics are, in general, the same, whatever the color. An apple orchard consisting of such varieties as Rome Beauty, Winesap, Jonathan, Rall's Genet, Grimes, and some others, planted on these clay lands, is certain to reward the owner who gives it intelligent attention. (Fig. 1.)

Adaptability of the Man.—It matters not how much nature may favor a locality with soil and climate, if she neglects to furnish the man with the necessary qualifications which go to make a successful fruit grower, the business will never amount to anything. The successful orchardist is born, not made. He must have a natural love for the business, or he is sure to fall short of reaching the highest results.

With a good foundation to build on, education and experience along this line will accomplish wonderful results; but it is as true in apple-growing as in any other business, that education does not make the man, but it will wonderfully inprove him after he is made. What we need, then, in this state, is men with an unlimited amount of push and energy, coupled with the proper amount of intelligence directed along right lines to carry out the plans and general principles which are essential to apple culture, and the results will take care of themselves.

Some of the Points which the Beginner should Keep in Mind.

There are a few general principles which should always be kept in mind in planning for and planting an orchard.

(1) **Selection of a Site.**—One of the most important points in the starting of an orchard is the selection of a suitable site. Neglecting to do this is one of the principal reasons why so many orchards throughout the state are unprofitable. The trees were planted either upon unsuitable soil, or where the general lay of the land was not suitable for a strong, vigorous growth of the trees, without which a maximum crop of fruit cannot be expected.

The site for an orchard should be high, or relatively high.

This will admit of good soil and atmospheric drainage, both of which are absolutely essential to the highest success. Even a few feet above the general level will often be sufficient to prevent winter killing. We must remember that warm air rises and cold air settes into the low lands and hollows just as water flows down hill to the creeks and rivers. A difference of one hundred feet in elevation between two points, in a still cold night will often make a difference of ten to fifteen degrees in temperature. This would often be sufficient to destroy fruit buds in the low lands, while those on the higher elevations would escape. In order to show the effect of only a slight elevation, when the temperature is near the danger line, I will give an example that came under my observation recently. A peach orchard in Southern Indiana was planted on comparatively level land. The winter being quite severe, the owner, after examining the buds which could be reached from the ground, pronounced them all dead. Later on it was founnd that while those on the lower limbs were killed, the upper half of the trees produced a good crop of fruit. The danger line in this case was about six or seven feet above the surface of the ground. Doubtless, too, a better circulation of air in the tops of the trees contributed a good deal towards their escape from frost.

On the other hand the orchard should not be too much exposed to severe winds. If it becomes necessary to plant the orchard upon a high elevation, which is exposed to the sweep of cold winds in winter as well as the severe winds of summer, it will be well to protect it on the north and west with a row of Noway spruce.*

If the trees composing the screen are placed just far enough apart so that the branches will intermingle after a few years' growth, they will check the force of the wind, but allow it to pass through at a moderate velocity which will be better for the orchard, both winter and summer, than stopping it altogether.

The Soil.—Any good, strong soil will do, preferably a clay loam, well drained, with a subsoil capable of holding much mois-

*I would not advise using the Red Cedar on account of the Orange Rust which often attacks the apple leaves, and which starts on the Red Cedar.

ture for the use of the trees during a drouth, and while developing their fruit. Black, mucky soils often found in river bottoms and low places, are not at all suitable for fruit trees, as it tends to produce a rank, succulent growth which is easily winter killed, and entirely unsuitable for the production of fine fruit. Soil that will produce a good crop of wheat, *if it is high enough*, will produce a good apple orchard. Trees grown on such soil will make a good, healthy growth and go into winter quarters in prime condition. Such trees seldom winter kill.

Selection of Varieties.—Next to the location a proper selection of varieties is perhaps the most important. It is to the orchardist what the selection of the breed is to the stock man. In selecting varieties for a commercial orchard the following points should be considered: (1) What varieties will do best in the particular locality? (2) What varieties will sell best in the markets which it is proposed to supply? In general, for market, a variety should combine the following qualities, and in the order named: Hardiness, productiveness, beauty and quality. This is admirably illustrated in the Ben Davis apple. For a number of years no other variety has been so successfully grown and marketed in such large quantities throughout the Central West as this; simply because the tree is hardy, a good grower, productive, and when properly cared for, bears large, handsome fruit, but of hardly medium quality; and yet it brings good prices in our city markets where people depend very largely upon the eye in selecting their fruit.

Then, too, for a commercial orchard, one should choose only a few standard varieties, but plant enough trees of each to make it worth while for a buyer to look at them. If they are intended for home use and a home market only, then choose fewer trees of a greater number of varieties so as to extend the season throughout the year.

In Farmers' Bulletin No. 208, on varieties of Fruits Recommended for Planting, recently published by the United States Department of Agriculture, and compiled by Hon. W. H. Ragan, whom most of our older fruit growers know well, that portion of Indiana north of latitude 40°, is placed in the same fruit district with Northern Ohio, Michigan, Northern Pennsylvania, the

greater portion of New York, Connecticut, Massachusetts, and the south half of Vermont, New Hampshire and Maine. All that part south of latitude 40° is placed with Southern Ohio, Southern Pennsylvania, West Virginia, the west half of Virginia, and North Carolina, Kentucky, Tennessee, Northern Georgia, Alabama,Arkansas, Indian Territory, Oklahoma, Southern Missouri and Illinois.

The following list of varieties is adapted to Indiana especially:

List of Varieties for Northern Indiana.

For Home Use.—Baldwin, Benoni, Fallawater, Fall Wine, Fall Pippin, Fameuse, Gideon, Golden Russet, Golden Sweet, Grimes' Golden, Hubbardston, Jeffries, Jonathan, King, Maiden Blush, Northern Spy, Oldenburg, Peck Pleasant, Porter, Red Astrachan,, Rhode Island Greening, Sweet Bough, Stark, Tetofsky, Talman Sweet, Wagener, Wealthy, Western Beauty,Yellow Transparent, York Imperial. Crabs—Red Lake, Martha, Whitney.

For Market.—Baldwin, Grimes' Golden, Hubbardston, Jonathan, King, Northern Spy, Oldenburg, Rhode Island Greening, Stark, Totofsky, Wealthy, Yellow Transparent, York Imperial.

List of Varieties for the Central Section.

For Home Use.—Bailey Sweet, Benoni, Chenango, Early Harvest, Fallawater, Fall wine, Grimes' Golden, Indiana Favorite, Jeffries, Jonathan, Maiden Blush, Pewaukee, Oldenburg, Rall's Genet, Rambo, Red June, Rome Beauty, Roman Stem, Roxbury Russet, Salome, Smith Cider, Wagener, Wealthy, White Pippin, Winesap, Wolf River, Yellow Transparent, York Imperial. Crabs—Red Lake, Martha, Whitney, Hyslop.

For Market.—Ben Davis, Gano, Grimes' Golden, Indiana Favorite,Jonathan, Maiden Blush, North Western Greening, Oldenburg, Pewaukee, Rome Beauty, Stark, Twenty Ounce, Wealthy, Winesap, Yellow Transparent, York Imperial.

List of Varieties for the Southern Section.

For Home Use.—Benoni, Early Harvest, Jonathan, Grimes' Golden, Maiden Blush, Oldenburg, Rall's Genet, Rome Beauty,

Salome, Wealthy, Winesap, Yellow Transparent. Crabs—Kentucky Red, Cider.

For Market.—Benoni, Ben Davis, Gano, Grimes' Golden, Jonathan, Rome Beauty, Winesap, Yellow Transparent.

Black Ben Davis may eventually surpass the old Ben Davis as a market apple, but it has not been tested sufficiently on our soil to give it a standing in our state.

Wolf River is a very large and showy apple, but drops badly, and is also subject to rot while yet on the trees; so it can not be classed as a valuable market variety, except, perhaps, in certain localities. While there are a number of Russian varieties grown in the Experiment Station orchard which are very good summer and fall apples, I have yet to see a first-class winter variety for this climate.

Procuring the Trees.—Unless a man has had some experience in grafting and budding apple trees, it will usually be cheaper for him to buy his trees ready grown than to attempt to propagate and grow them himself. The propagation of trees has come to be a business in itself, and is not generally entered into to any great extent by the commercial fruit grower. The question that concerns him most is how to procure trees that have been well grown, *and are true to name?* In answering that question I would say procure the trees direct from a good, reputable nurseryman, one who has a standing in his community, and a reputation for honesty and fair dealing, and the probabilities are that the trees and the varieties will be what they are represented to be. It does not matter whether they have been grafted upon whole or piece roots. Experiments along this line in the Experiment Station orchard show very conclusively that during the first ten years, at least, there is no perceptible difference in the growth or bearing qualities of trees which have been propagated by these different methods.

In general procure the trees from as near home as possible. If, however, circumstances seem to make it desirable to send to other states for the trees, I would prefer to send either East or West rather than very farm North. A winter variety in Minnesota or Wisconsin is very likely to become a fall variety when grown in Indiana. Trees from very far South had better be

planted in the spring in order that they may have one season in which to become established before cold weather.

Treatment During the First Five Years.—All that should be expected of a tree during the first four or five years is that it should make a strong, healthy, vigorous growth. The energies of the grower, then, should be turned in that direction. Prepare the ground as for a crop of corn, always remembering that it can not all be plowed again after the trees are once set, hence the importance of thorough preparation at the outset. Set the trees either in the fall or spring; I would prefer the fall. Set them not less than two rods apart each way, forty feet would be better for large spreading varieties like Rhode Island Greening. Trees often suffer for the want of room, seldom by having too much. Cut off all roots whether broken or not, to within five or six inches of the trunk (I am inclined to think that further experiments will prove that three or four inches will be better) at the same time cut back the top to correspond with the loss of roots. If the trees are planted in the fall, the ends of the roots will have formed a callus by spring and a fresh, new lot of feeding roots will soon begin to push out and be able to furnish a greater supply of plant food to the top than they would have done had all of the original roots been left on. Our experiments for several years along this line have proved very clearly that the trees that were pruned according to the Stringfellow method, which is still more severe, and planted in the fall, have made a better root system, and produced from one-fourth to one-third more growth of top during the first season than those planted in the usual way.

Make the rows perfectly straight by first laying off the field and placing a small stake where each tree is to stand. Procure a broad six inches wide and about five feet long and bore a hole an inch in diameter in each end and cut out a notch exactly in the middle like Fig. 2.

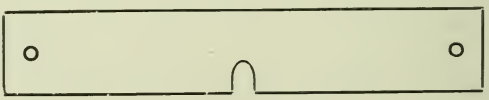

Fig. 2.

When a tree is to be planted place the notch around the stake where the tree is to stand then put other pegs through the

holes at the end, lift off the board and dig the hole, then place the board back over the pegs, place the tree in the notch, and fill in the soil. Proceed in this way till all the trees are planted. It will be seen at once that if the stakes were set in straight rows the trees must be also, because each tree stands exactly in the place of a stake. By this simple process several sets of men may be at work at the same time in different parts of the field.

Set the trees just about as deep as they grew in the nursery row, leaning them a little towards the prevailing winds. Place good surface soil around the roots and firm it well by tramping so that the young, feeding roots will come into immediate contact with the plant food as soon as they start. No water is necessary unless the soil is unusually dry. Do not place manure of any kind in immediate contact with the roots, unless it is well rotted and has been first well mixed with the soil. No mulch will be necessary if the soil is kept loose by frequent cultivation as explained farther on.

Make a Plat of the Orchard.—As soon as the trees have been planted, procure a sufficient quantity of zinc or copper labels, upon which stamp or write the name of each variety, and attach one to each tree or each row, if the entire row consists of one variety. Then as a double safeguard against the loss, and consequent confusion of names, procure a blank book and in it make a plat of the orchard, locating each tree by means of a dot or circle, and numbering these from one end of the row to the other, thus:

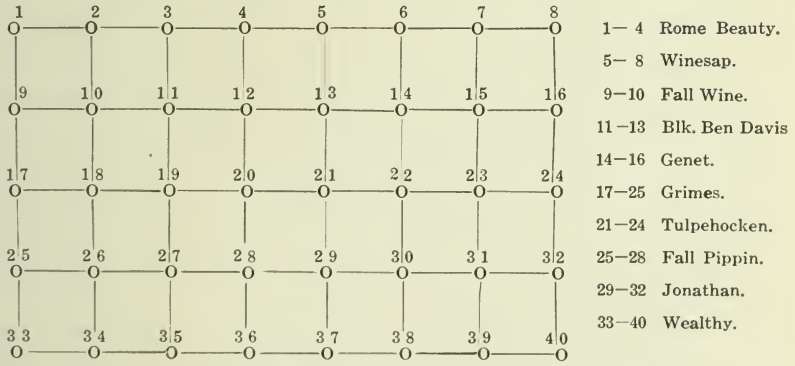

FIG. 3. Example of plat of trees.

This will enable one to find the name of any tree in the orchard at any time, whether the label has been lost or not. If such a plat were made by every orchardist at the time the trees were planted, and before the little wooden labels have been lost, much of the confusion of names so often seen at our county fairs would be avoided.

Protection against Mice and Rabbits.—If the soil around the young trees has been kept well cultivated, and free from grass and weeds, there will not be much danger from mice gnawing the bark off during the winter; but rabbits are very liable to do much injury during the winter, when all else is covered with snow, by eating off the bark and tender branches where they can be reached. A good preventative against the attacks of both of these pests is to make a mound of earth a foot high around the base of each tree, making a smooth surface with the back of the spade. I have practiced this for several years without the loss of a single tree. It should be done just before winter sets in, and the mounds pulled down again the following spring.

A more permanent protection against rabbits may be given by the use of an inch-mesh poultry netting, cut the proper width to wrap around the tree, fastening it in place with one or two wires. It should be made large enough to allow for two or three years' growth of the tree without crowding, after which it will need no protection.

Cultivation.—Give the young trees the same care that you would give a field of corn which you expected to yield a maximum crop. That means that they should not be set in a field of oats, wheat, rye, blue grass or any other sowed crop, but it does not prevent the growing of a crop of corn, potatoes or beans in the orchard for possibly three or four years after planting, providing the soil is kept well fertilized, and providing, also, that the owner does not think more of the crop of corn, etc., than he does of the trees. Never allow a careless hired man to run the cultivator in an orchard. Such a man is about as injurious to young apple trees as a flock of sheep, or a drove of horses or cattle, neither of which should be tolerated in a newly set orchard. Horses and cattle are out of place there at any time.

Unless the land is quite rolling, keep it well cultivated until

the trees begin to bear; feed them according to their needs, and use a cover crop for fall and winter protection, to be plowed under in the spring. In most parts of Southern Indiana the orchard lands are too rolling to admit of constant cultivation, and so the mulch system may be substituted there to advantage. In fact it is absolutely necessary in some sections to keep the soil covered at all times, except a small space around the trees, with some cover-crop, like cow peas, soy beans or rye, which may be worked into the soil with a disk or cut-away harrow, thus keeping the surface porous and preventing washing, and also keeping up a good supply of humus in the soil.

After the Trees Begin to Bear.—The principal elements needed after the trees begin to bear, are plenty of water and food furnished in an available form through the growing season, so that when growth begins in the spring there will be no let up until the season's growth has been completed. This will usually be in sufficient time to allow the new wood to ripen up for winter, which will, to a very great extent, prevent winter killing, and aid very materially in developing the keeping and other good qualities of the fruit. An apple that is only half grown is never so good in any respect as when its growth has not been interfered with, and it has been allowed to reach its normal size and color. This has been very noticeable in the Experiment Station orchard. The land on which the orchard stands is underlaid with gravel for a hundred feet or more in depth, and coming within eighteen inches or two feet of the surface. The reservoir beneath the trees which should hold the surplus moisture for the use of the trees in cases of emergency, has practically no bottom, and so in seasons of long continued drouth the trees suffer very greatly from a lack of moisture, and the fruit often drops prematurely. Not only that, but the annual growth of wood is often not more than one-half what it should be. Uuder such conditions there may be an abundance of plant food in the soil, but the trees are unable to make use of it.

The soil may lose its moisture in two ways—by going down so far that the roots are unable to reach it, or by evaporation from the surface of the soil and through the leaves and other growing parts of the plant. It is well known that when soil is

left bare, and a hard crust is allowed to form on the surface, evaporation goes on very rapidly, and unless this is made good by frequent rains, or from below by capillary action, it is only a question of time when the soil will become very dry and hard, and the trees will suffer. It is also well known by those who have given the matter attention, that from parts of plants exposed to air, water is constantly passing off by evaporation. This is, of course, much less in the older parts of plants than in the new, especially from the leaves, which expose a large surface to the atmosphere. In fact this is the chief source of evaporation from all of our higher cultivated plants. It has been estimated that the evaporation from leaves is about one-third that from an equal area of water, or in other words, the evaporation from a tree twenty feet high and containing approximately 700,000 leaves, during the growing season, amounts to several times the rainfall upon the area covered by its branches. Not only is this true, but a large amount of moisture is also given off by the growing fruit. How necessary then that this supply be kept up, so far as possible during the hot, dry months of summer, in order that the fruit may continue to grow until ripened up naturally. There are two ways by which nature may be assisted very materially in conserving the surplus moisture which has been stored up in the soil during the early part of the season, viz:—(a) by a constant cultivation, and (b) by mulching. These are only different methods of accomplishing the same result, and the one to be recommended will depend largely upon the conditions.

In some parts of the country some of the best fruit growers advocate and practice constant cultivation, at least until the trees get so large as to make it impracticable, sowing some kind of a cover crop late in the season in order to prevent the loss of plant food, and also to prevent washing during the fall and winter. This is undoubtedly the best method for those localities as is indicated by the abundant crops produced. But as has been stated, in portions of Indiana, where the land is quite rolling, and where the soil washes badly during heavy rains, the mulch system is the best, in fact the only practical method. This is done by keeping the soil constantly covered with some kind of growing crop.

It may be grass, or it may be clover or something else, depending upon the character of the soil. (Fig. 4.)

Fig. 4. View in the Burton Fruit Company's Orchard at Mitchell, Indiana, where grass and cow peas are used as a mulch.

It should be remembered here that there are two classes of cover crops, and they should be used according to the needs of the land. These are called the nitrogenous and the non-nitrogenous plants. To the first class belong the clovers, vetches, cow peas, soy beans; those plants which gather free nitrogen from the air and store it up in the soil by means of the little nodules on the roots. The non-nitrogeneous class consists of such plants as rye, oats, barley, orchard grass, and in fact all of the grasses proper. These plants add humus to the soil when plowed under and assist in making available the plant food already within the soil. In order to determine which of these crops is needed the orch-

ardist has only to consult his trees, just as the stockman consults his cattle. If the foliage has taken on a sickly color, and the branches are not making from one to two feet of growth each season, it is very evident that the soil is deficient in nitrogen, and this may be obtained in the cheapest possible way by raising one of the nitrogenous crops and plowing it under. On the other hand if the trees are making too much growth and too little fruit, sow one of the non-nitrogenous plants, such as oats, rye or grass as a cover crop, and add 300 to 500 pounds each of murite of potash and ground bone or acid phosphate, which will supply the necessary materials which go to make up the fruit. A ton per acre of unleached hard wood ashes sown broadcast will furnish a goodly supply of potash. One thing to be remembered, where the mulch system is practiced, is that it is absolutely necessary that the crop be left on the ground, not cut and taken off for fodder with nothing left to replace it. This is simply robbing the trees of both moisture and mineral elements to feed the stock. There are several orchardists in this state who have practiced the grass mulch system for years, and who have been remarkably successful; and there are others who have tried it with very indifferent success. Doubtless local conditions have much to do with the success or failure of the method.

Pruning.—Dr. Lindley once said: "If well directed, pruning is one of the most useful, and if ill directed it is among the most mischievous operations that can take place on a plant." The beginner is more liable to prune too much than too little. He is also liable to wait too long before beginning the shaping of the top. This will most likely result in too severe pruning when he does begin, making it necessary to cut off large branches that should have been cut off when they were small. The time for the first pruning is while the tree is still in the nursery row, and not more than two years old. The shaping of the top is done when the tree is transplanted into the orchard. This is the time to decide whether a high or a low top is wanted, and to prune accordingly. If constant cultivation is to be practiced, the tops must not be started too low, but if the mulch system is to prevail a rather low top is better. The amount of thinning which the top should receive depends largely on climatic peculiarities. In sections of

the country where the season is short and consequently the amount of sunlight is much less than in other portions, a different method must be employed. Prof. Card, of Rhode Island, says on this subject: "The Eastern grower finds it necessary to thin his trees and admit light and air to produce fruit of high color and good flavor. The Western man, however, finds that under his conditions of intense sunlight and low humidity, fruit will develop color regardless of such conditions. The Eastern grower, if he neglects this, may find his fruit suffering from attacks of fungous diseases, but in general, fungi are less troublesome in the drier climate of the plain, so this reason loses its force." In general the amount of thinning out required will depend very largely upon the variety; but one thing is certain in this state, we can not have highly colored fruit without an abundance of air and sunlight.

Objects of Pruning.—Trees are pruned chiefly for some or all of the following reasons: To check the growth of the top in certain directions; to prevent the limbs from crowding; to induce fruitfulness, and to prevent overbearing.

Time to Prune.—The man that lives with his trees will usually follow the old rule and prune whenever his knife is sharp; which simply means that whenever he finds a branch growing in the wrong place, he at once takes it off while it is yet small and while it will do the least injury to the tree. For the general pruning which usually comes but once a year, the best time is in the spring about the time that growth begins and the leaves are beginning to unfold. At this time all wounds will heal over quickly, and the growth will proceed rapidly. If large limbs are to be removed or severe heading back is made, it should be done while the tree is perfectly dormant, preferably late in the fall. Summer pruning is often practiced in order to promote fruit bearing instead of too much growth. Much summer pruning, however, should be done with some caution, as it tends to reduce the vigor of the tree. The following are good rules to follow: Prune so as to avoid bad crotches; make the top as even as possible; avoid cutting off large branches as much as possible, and cut off the branches close to the tree so that the wounds may heal over quickly. Strive to encourage fruit spurs to form well down on

the branches so as to distribute the load throughout the top as much as possible. Varieties differ very much in this respect. Grimes naturally distributes its fruit throughout the top and consequently is able to carry a heavy load without breaking down, while others carry their entire load near the ends of the branches. The observing grower will soon learn these peculiarities.

The following from Downing should be committed to memory by every orchardist: "Every fruit tree grown in the open air should be allowed to take its natural form, the efforts of the pruner going no farther than to take out all weak and crowded branches. All pruning of large branches in healthy trees should be avoided, by examining them every season and taking out superfluous shoots while small."

Thinning.—The importance of thinning apples is not well understood, as is evidenced by the poor quality of much of the fruit that is put upon the market. Not one farmer in a hundred ever thinks of thinning his apples except that which is caused by an occasional pruning.

There are two principal reasons why apples as well as other kinds of fruit should be thinned if the trees are too heavily loaded. (1) The effect which it has upon the tree, and (2) the effect produced upon the fruit. *Seed production is a very exhaustive process upon the plant.* Other prosesses, such as foliage, the green shoots, etc., assist in the assimilation of plant food, but the seed assimilates practically no food. On the other hand, it removes a large amount of assimilated food from other parts of the plant, which it stores up as a reserve supply for the young embryo. The florist knows that if he allows his sweet peas or other flowering plants to ripen their seeds, the plants will soon die, consequently the flowers are picked almost as soon as open. The vegetable gardener is aware that if so much as one cucumber on a vine is alowed to ripen its seeds, the life of that vine is considerably shortened; hence the fruits are picked while green. The same rule will hold good with orchard fruits. An apple tree that is allowed to overbear is injured more or less for the remainder of its natural life. Everybody knows that the fruit on such a tree is never so large and fine looking, nor of as good quality as it is on a tree that bears but a moderate crop. There are just about as many

seeds in a small apple as there are in a large one of the same variety. In other words it exhausts a tree far more to produce a bushel of small apples than it does to produce a bushel of large ones. This is another reason why so many trees that are inclined to bear heavy crops, are so short-lived. The Wagener apple, which is prized so highly in the East, will often begin bearing the second year after planting, and if allowed to have its own way will soon bear itself to death. The Wealthy often bears in the nursery row, and yet even in its home state (Minnesota) it is a very short-lived tree. Much of this trouble can be avoided by preventing it from bearing until it has attained sufficient age and then by properly thinning the fruit. It has come to be accepted by many as a law of nature for most trees to bear only each alternate season, when the fact is they are naturally annual bearers, but the trees have become so much exhausted of their stored-up food supply it requires a year in order to recuperate sufficiently to be able to form fruit buds for the succeeding crop. By properly thinning the fruit, most varieties can be induced to bear every year, provided other conditions are favorable.

Time for Thinning.—This should be done as early as possible after it can be determined how large a crop the tree is likely to carry. Many of the young fruits will drop ofo their own accord, which is due to various causes, one of which is a lack of vitality in the tree owing to previous heavy crops. Another is a lack of pollen, which may be due to the weather and cnsequent scarcity of insects. The proper amount of thinning will depend upon various conditions, such as age of the tree, abundance of the crop, fertility of the soil, water supply, amount of pruning, etc., and must be determined very largely by judgment and experience.

Picking and Marketing Apples.—When the orchard is located near a good market town, or when the shipping facilities are of the best, it will often pay well to plant a goodly number of trees of the summer and early fall varieties; but unless this is the case fall and winter varieties will usually pay best. Summer apples should be left on the trees until some of them are ripe, that is, until some specimens, begin to get soft, in order to secure the best flavor, and so of course they should not be expected to keep for a very long time, unless put into cold storage. The

stems should not be pulled out when picked, and the fruit should be handled as carefully as eggs are handled while being packed for market. Any breaking of the skin, or bruising the flesh will very materially hasten the time of decay. They should be carefully sorted, and marketed in boxes or baskets holding not more than one-half bushel, so that they can be sold without breaking the package. This is especially true when the fruit is sold in the larger cities where very many people buy only a few apples at one time. And as a general rule, the neater the package and the more uniform the fruit throughout the package, the more readily they will sell.

Fall and Winter Varieties should be packed when mature

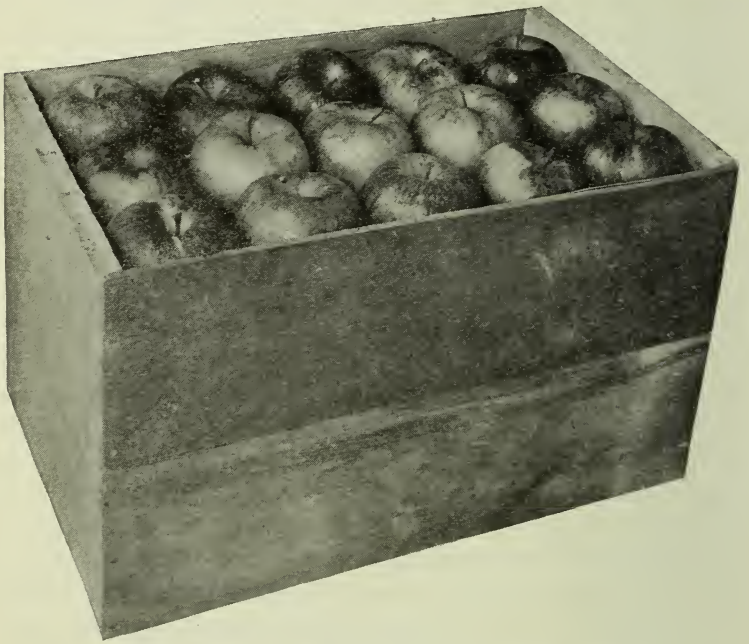

FIG. 5 Shows a bushel box of No. 1, Rome Beauty.

but not ripe. An apple is mature when the stem will separate readily from the branch as it is given a little twist. At this time the seeds are beginning to take on their brown color, indicating that the period of ripeness is approaching. If handled in the

same manner as indicated for summer fruit, but packed in barrels or bushel boxes and stored at once in a cool place, they can be held very nicely for a later market.

Whatever the kind of package used, whether it be barrel or box, let it be new and of the regulation size, and let the fruit be so graded that it will be uniform from top to bottom. Remember that a man's reputation is worth more than a few cents made on a snide barrel of apples. Figs. 5 and 6 show two boxes of Rome Beauty apples properly graded and packed. Fig. 5 contains number "ones," and Fig. 6 contains "seconds." The box of "seconds" holds, in this case, just twice as many apples as the box of number "ones," and yet the latter will bring at least one-third higher price in the market than the other.

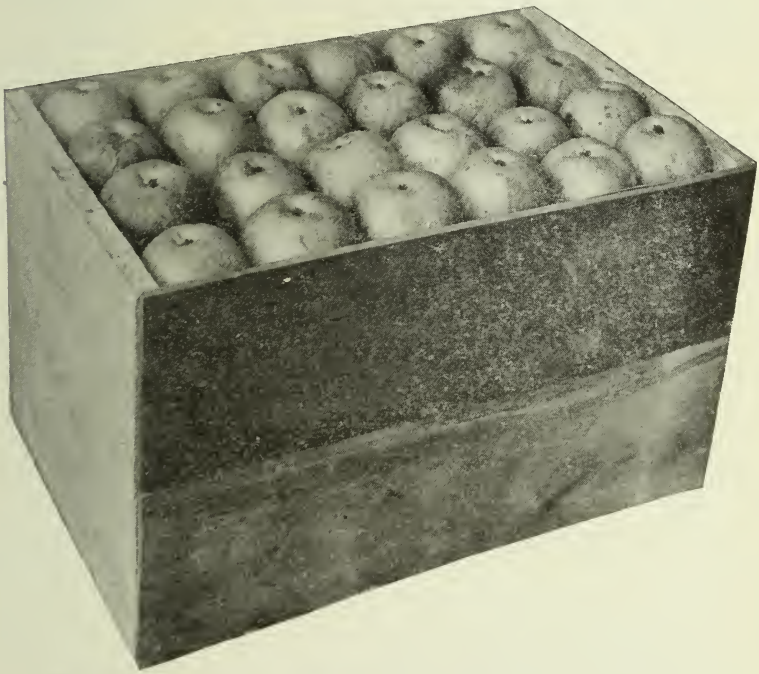

FIG. 6 Shows a bushel box of "Seconds" of the same variety.

Unfortunately nearly every maker of fruit packages seems to have adopted a size of his own, so that we have no uniformity in this matter as we should. Fig. 5 shows a bushel box made in Illi-

nois, which measures 16¾ inches in length, 11 inches in depth and 10¾ inches in width, inside measure, which contains 1980.69- cubic inches. Another box manufactured in Michigan, is 21⅛ x13⅛x7⅞ = 2183.46- cubic inches. A standard bushel contains 2150.42 cubic inches. It will be seen that the first one falls short of a bushel, while the second slightly overruns. This is offset, however, by a cross piece through the center of the box for the purpose of stiffening it.

The following standard sizes for both packages and fruit, was adopted by the American Apple Growers Congress in 1903:

"Resolved, That this congress adopt as a standard barrel for apples,—a barrel which is of the capacity of three bushels, which is 17⅛ inches in diameter of head, 28½ inches length of stave, and bulge not less than 64 inches in circumference, outside measurement.

"A standard bushel box shall be 11½x11½x20½ inches, inside measurements; sides should not be less than ¼ to ⅜ inches thick for domestic use and not less than ⅜ inches for export, ends or heads not less than ¾ inches thick."

A number one apple shall not be less than 2½ inches in diameter, and shall include such varieties as Ben Davis Willow-twig, Baldwin, Greening, and other varieties kindred in size,—and varieties such as: Romanite, Russet, Winesap, Jonathan, Missouri Pippin and other varieties kindred in size shall not be less than 2¼ inches in diameter, and further, a number one apple shall be practically free from the action of worms, and not over 10 per cent. of the apples affected by defacement of surface; shall be hand picked from the trees and not bruised or skin broken; shall be of a bright and normal color and shapely.

Number two apples may be ¼ inch less in diameter than number one apples and not over 20 per cent. of the apples affected by defacement of surface, by scab, dry rot, worms or other defects; shall be hand picked from the trees and not bruised or skin broken; shall be of a bright and normal color and shapely.

When apples are marketed in packages of either a barrel or box they must be well faced and carefully packed, well settled and sufficiently full to keep them from shaking in packages in

handling, and shall be in sound barrels or boxes, sides of boxes and heads of barrels securely nailed."

Storing.—A very satisfactory place for storing apples is an outdoor cellar, one that is entirely separated from the dwelling. If the orchard is situated on a hillside it is a very easy matter to construct a cellar that will keep apples in good condition all winter. When the apples are picked the days are usually warm and the nights comparatively cool. The cellar should, therefore, be constructed so as to admit of thorough ventilation so that it may be opened during the night, admitting the cool air, and closed during the day so as to exclude the warmer air. Whether the temperature approaches the freezing point in the cellar or not, it should be kept as uniform as possible.

Our experience with Grimes' Golden during the past few years indicates very clearly that it will not do to put this variety into a temperature approaching the freezing point until the fruit has taken on its bright, golden color. This will usually be some time after the picking season. It should be placed in a cool place direct from the tree and kept there for a few weeks until it has had time to develop its best flavor and color, when it may be placed in cold storage and kept until the following summer.

The apple grower who visited the St. Louis Exposition the past summer, especially during the early part of the summer, doubtless was surprised at the fine condition in which most of the apples were found when taken from the cold storage houses. They were not all so, but by far the larger portion of them came out of cold storage seemingly in as fine condition as when they went in, so that many of the apples were able to "hold up" for two months or more after being placed upon the tables. This was due, principally, to two causes, viz: Picking at the right time, and careful handling and packing.

The successful keeping of apples in cold storage has not been practiced but about fifteen years, and it has been only within the last four or five years that this method may be said to have been reduced to a science. The Department of Agriculture at Washington, D. C., has recently published a Bulletin* on "The Apple in Cold Storage," which gives a large amount of valuable information

along this line, and those who are interested in this particular branch of the industry, are advised to send to the Department of Agriculture for this bulletin.

Use of the Score Card in Judging Apples at Fairs.

Those who have been called upon to judge apples at fairs have doubtless felt the need of some uniform system of marking such as is sometimes used in the judging of live stock. No man can pass on fifteen or twenty entries of fruit, keeping in mind the good and bad points of each while he is selecting the first and second best plates, except in a general way. The following score card, which is essentially the same as was used with such good results in the Horticultural Department of the St. Louis Exposition, will enable one to go over an unlimited number of entries, marking each one as he goes, and when he is through it is an easy matter to tell which has scored the highest number of points. By this method each entry is placed upon its own merits.

Score Card for Use at County or State Fairs.

Apples.

Class..... No. of Entry.....

POINTS NOTED	Max. Score	Score Awd.	REMARKS
Size of exhibit.....	20		
Size of fruit.....	15		
Color.....	15		
Form	15		
Quality	15		
Freedom from blemishes..	20		
Total..... ...	100		

Date. ..... Name of Judge.....

In case of single plates only, the first score may be omitted, leaving a total of 80 points.

AN EXPERIMENT.

Influence of the Stock Upon the Graft.—The question is often asked as to whether the quality of the fruit of a graft is influenced in any way by the stock upon which it is grafted? If this were true, then the theory of grafting one variety upon another in order to multiply or to preserve the identity of a variety, is false. For example, we graft an Angouleme pear upon a quince root, the result is a dwarf tree, but the fruit is still a pear, and not only that, but it is a genuine Angouleme pear. More than this, the wood above the point of union with the quince is pear wood, and that below that point is quince. The peach is budded upon plum stock, but the fruit is peach, and the tree is peach wood. Or graft the Northern Spy apple upon a seedling, or any number of seedling roots, all different, and the result is Northern Spy fruit, as well as Northern Spy wood. We naturally expect that to be true, because the food is assimilated by the leaves of the scion. But supposing the scion was deprived of its leaves, then what?

An interesting experiment to determine this point has been in progress for some years, conducted by the manager of the Experimental orchard in Lawrence county, Mr. Joe A. Burton, of Mitchell, Ind. Scions of the Yellow Transparent apple were inserted into branches of the Wild Crab. After fruit spurs were formed all leaves were removed from the graft and none were allowed to form during the season, so that all of the sap was elaborated by the leaves of the Wild Crab. At the same time another scion of the same Yellow Transparent tree was inserted into a twig of the same branch and allowed to form its own leaves. Both of these grafts have borne fruit the past season, which was tested by myself and others, and the general verdict was that no difference, either in size, color or flavor could be detected. In both instances the fruit was clearly Yellow Transparent.

This experiment would seem to indicate that it makes no difference where the sap comes from, the fruit will remain true to its kind.

Keep the Trees Free from the Attacks of Insects and Fungi.

One of the elements necessary in the production of a strong, vigorous tree, is a healthy foliage, especially during the first few months of summer when the tree is making most of its growth. This is the season when insects and fungi begin their destructive work.

As soon as the trees are planted in the orchard, they are exposed to the attacks of borers and leaf-eating insects, as well as the parasitic fungi which feed upon the foliage. The up-to-date orchardist will, therefore, provide himself with a first-class spray pump and at once prepare for these attacks. For the borers, a carbolic-soap mixture will be as useful as anything. This is made by adding a sufficient quantity of rain water to ordinary soft soap so that it may be readily spread on the tree with a brush. To five gallons of this mixture add five ounces of crude carbolic acid and mix. Two or three applications during the summer, beginning the latter part of May, will prevent the attacks of these insects.

For leaf eating insects, Paris green may be used (4 or 5 ounces to 50 gallons of water) or what is still better, boil in the open air one pound of white arsenic and four pounds of sal-soda with one gallon of water until dissolved. Keep this as a "stock mixture." When wanted for use, slack three pounds of fresh lime and after straining it add it to forty gallons of water. Then add one pint of the stock mixture and stir thoroughly.

We have used "Disparine," an insecticide made by the Bowker Insecticide Co., Cincinnati, Ohio, with good results, using three pounds to fifty gallons of water; but it is more expensive than Paris green, and many claim that the results are no more satisfactory.

Codling Moth.—As the trees come into bearing one of the first insects to attack the young fruit is the *Codling Moth,* (Carpocapsa pomonella). This is a small moth, seldom seen, which makes its appearance about the time the apple trees are in blossom. As the bloom falls and the young apples begin to form the female moth deposits her eggs on both the foliage and young

*Bureau of Plant Industry—Bulletin No. 48.

apples. The eggs soon hatch and the young larvae upon the fruit make their way to the blossom end where they eat their way into the apple, remaining there until full grown, when they eat their way out and at once look for a suitable place to pupate, either under a piece of bark or rubbish at the base of the tree.

Just after the blossoms have fallen, then, is the time to begin spraying. At this time the young apples are standing with their heads up, and the calyx is open so that a tiny drop of the poisoned liquid may easily lodge therein, and as the young larva begins to eat his way into the apple he necessarily gets some of the poison. As the eggs are not all laid at the same time, a second and third spraying at intervals of ten days will be in order. If rain intervenes an additional spraying may be necessary. If these early sprayings have been thoroughly done, there will not be much trouble from the second brood, which comes later in the summer, neither will the Canker worm or other leaf-eating insects do much injury.

The Apple Scab is more or less abundant every year, often doing serious injury to both fruit and foliage. This is best controlled by the use of the Bordeaux mixture. Use this first just as the buds are beginning to swell in the spring; and if Paris green is used for the later sprayings it should be used in connection with the Bordeaux mixture, which makes one of the best combination fungicides and insecticides known.

The Bordeaux mixture is made by dissolving five pounds of copper-sulfate and five pounds of fresh lime in separate vessels, and mixing them together in 50 gallons of water, after the lime has been thoroughly strained.

Scale Insects.—There are a number of species of scale insects which infest the apple trees as well as many other kinds of fruit and ornamental plants, to a greater or less extent, but of all those known to the entomologist at the present time, the San Jose scale (Aspidiotus pernicious,) (Fig. 7), is the most to be dreaded, on account of its destructive character, the rapidity with which it propagates, and the difficulty which one experiences in trying to eradicate it when it once becomes established.

Our experiments and observations during the past few years have demonstrated two important facts concerning this insect. First, that it is more widely spread throughout this state than is generally supposed by orchardists; secondly, that by the use of proper materials in the hands of a competent man, it may be practically cleaned out of an orchard in a single season, if the trees are not too far gone when found.

Numerous instances have been brought to my attention the past year of infested orchards in localities where it had not been

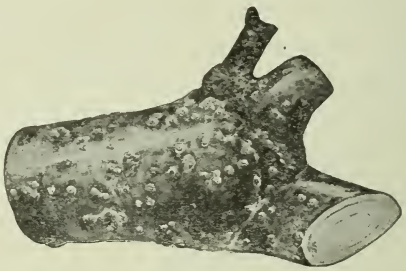

Fig. 7. A branch infested with the San Jose scale.

known before, so that up to the present time it has been located in forty different counties in this state.

It is found on nearly or quite all species of fruit trees, and numerous shade and forest trees as well. An Osage orange hedge around an infested orchard makes an admirable breeding place for the insect, and one from which it would be almost impossible to eradicate it except by fire. In looking for it most people will pass it by unnoticed on account of its minute size and unattractive appearance. The shape of the female, which is wingless, is nearly circular in outline, while the adult male is more elongated and provided with wings. The female scale is sharply convex in the center. This last character will help one to distinguish it from most of the more common species. Another distinguishing character is found in the reddish discoloration of the bark immediately surrounding and underneath the scale. After the tree has become entirely coated with the scales it presents a dirty, greyish color. At this stage if the tree is bearing fruit, many of the apples will be covered with the scales and show the character-

istic little reddish-grey spots, (See Fig. 8), which renders them entirely unfit for market, and very unattractive for home consumption.

Remedies.—It is needess to say that where trees have been infested so long as to be practically dead when discovered, the only remedy for them is the ax and fire. But a tree may be pretty

FIG. 8. Apples infested with the San Jose scale.

thoroughly infested by the scale, and yet be treated so as to restore it to its normal vitality again. So it becomes a very important matter with every owner of an orchard or even of a city lot, if situated anywhere near an infested tree, to see to it that the evil is remedied as soon as possible. The law makes this obligatory upon every owner of infested trees or orchards.

Section 8, of the Nursery Inspection law, reads as follows: Whenever a nurseryman, fruit grower, or agriculturalist, in this state shall know or have good reasons to believe that his trees, shrubs, vines or plants are affected with San Jose scale, yellows, rosette, or other destructive insects or fungus enemies, he shall

have the privilege, and it shall be his duty to notify the State Entomologist, who shall proceed in person or by his assistant, to examine the same without delay, and advise the proper remedies for the destruction of such insect or fungus enemies that may be present. In case the owner or owners, or persons in control of said affected trees, shrubs, vines or other plants do not apply the proper remedies recommended by the said State Entomologist, within a certain specified time, said owner or owners, or persons in control of, shall be liable to a fine of not more than twenty-five dollars ($25) nor less than ten dollars ($10) and costs, in the judgment of the court, for every such offense, the fine to be recoverable in the same manner as that provided for in section 5 of this act: *Provided*, That in case of an objection to the findings of the State Entomologist an appeal may be taken to the Circuit Court of the proper county whose decision shall be final; said appeal must be taken within three days, and shall operate as a stay of proceedings until it is heard and decided.

Summer Treatment.—The young insects begin to make their appearance as soon as warm weather is well under way, and are then active, crawling about on the branches, looking to the naked eye like very minute particles of orange-colored dust moving about.

At this stage they are easily destroyed by contact poisons, such as kerosene emulsion or whale oil soap. But owing to the dense foliage on the trees at this time, many of the insects are liable to escape, unless the work is thoroughly done. The whale oil soap solution is made by dissolving one pound of the soap in one gallon of water. Apply in a fine spray so as to moisten every part of the tree. Two or three applications should be made at intervals of ten days, beginning with the first of June.

Twenty per cent. kerosene emulsion made with soap and kerosene oil, and used in the same manner as the whale oil soap solution will give good results as a summer wash.

Winter Treatment.—Late fall or winter is the best time to apply remedies for this scale, because the foliage is gone and the material can be used much stronger. The most practical treatment for winter use is the lime, salt and sulphur wash. This treatment is used only when the trees are dormant, and preferably in

late fall and in the spring just before the buds begin to swell.

There are two formulas in common use. One is called the "California Wash," and the other is the "Oregon Wash." The first is made of 50 pounds of fresh lime, 50 pounds of ground sulphur and 50 pounds of salt. Slack the lime in a little hot water, gradually adding the sulphur, stirring constantly, and boil one hour. Then add the salt and boil fifteen minutes longer, strain, dilute with hot water to make 150 gallons and apply immediately.

The "Oregon Wash" is made in the same manner, except the salt is replaced by 4 pounds of copper sulphate. A good iron or brass barrel pump, without copper or leather, is recommended for this purpose. Always thoroughly clean the pump and hose after using, by the use of clear water, else they will soon become clogged.

Caution.—If any open sores exist on the hands protect them with rubber gloves. Keep the horses blanketed while the spraying is in progress. See that every part of the tree is covered with the mixture. Remember that everything must be thoroughly done from start to finish in order to secure the best results.

The Oyster Shell Bark-louse (*Mytilaspis pomorum,*) Fig. 9, is a very common form of scale. It derives its name from the fact that the female scale resembles somewhat closely the oyster shell.

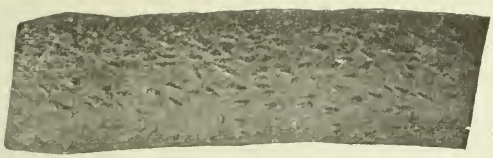

Fig. 9. A branch infested with the Oyster-shell Bark-louse.

It is more or less common on apple and other fruit trees, and while it sometimes becomes numerous enough to seriously affect the vitality of the tree, yet I have never known of its killing a tree.

The Scurfy Bark-louse (*Chionaspis furfurus*).—This is a native species, more widely distributed than most of the scale insects. The scale is large enough to be recognized by the naked eye (Fig. 10.) The female scale, shown enlarged on the right, is broad at

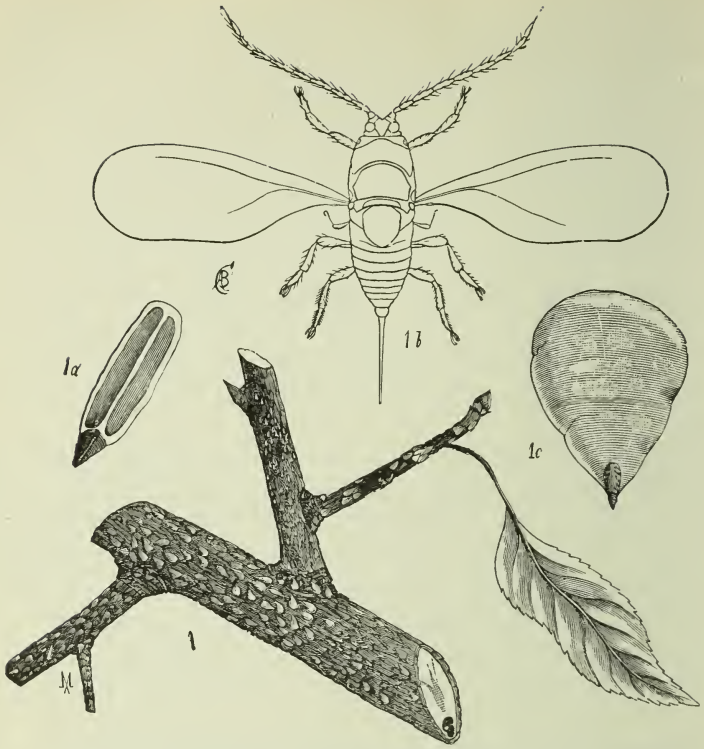

FIG. 10. Showing the Scrufy scale—1a, male scale; 1b, the winged male insect; 1c, the female scale, all enlarged; 1, an infested branch, natural size.

one end, tapering towards the other upon which is a little brownish scale. The male scale, shown at the left, is more elongated, and much smaller than the female.

The female is wingless and seldom travels any great distance. In neglected orchards this scale often becomes a serious pest, but when the orchard is thoroughly sprayed and cared for in other ways it seldom causes any trouble. The same remedies as recommended for the San Jose scale will apply here.

Finally.—Eternal vigilance is the price of good fruit.

Purdue University

Agricultural Experiment Station

BULLETIN NO. 103. VOL. XII.
MARCH, 1905.

Rapid Method of Removing Smut from Seed Oats

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Rapid Method for Removing Smut from Seed Oats.

By J. C. Arthur.

The farmer who raises oats is very likely to sustain a considerable loss of his crop from the presence of smut in the field. Oat smut is a fungus that starts when the seed germinates, grows inside the stalks, using part of the nourishment of the oat plant, thereby preventing the stalks attaining full height, and winds up its career by turning the grain, and often the chaff, into a black powder, which is made up of the reproducing spores of the fungus. If this black powder gets upon the seed grain sown the following year, the resulting crop will be correspondingly injured by smut.

Oat smut is very common throughout the state and the country at large. Unless preventive measures have been taken, almost any field will show from a few per cent. to ten, fifteen, twenty-five, or even fifty per cent. of smut. Any amount under ten per cent. attracts little or no attention, because the affected stalks are for the most part so much shorter and less conspicuous than the healthy ones, due to the dwarfing action of the fungus. There is abundant literature to substantiate these statements in reports made by the various state experiment stations (see Indiana Bulletin No. 35, for 1891). If any farmer doubts that he is losing from one to ten bushels or more of oats out of every hundred that he harvests, let him go into his field and count every stalk, little and big, to the extent of 500 or 1000 in different parts of the field, making note of the number of those blasted with smut, and he will be surprised at the result. He should not be deceived into thinking that some of the stalks are too small to be worth counting, for if it had not been for the attack of smut they would have been as large as the others and borne full sized heads of good oats.

This station has long worked on the problem of preventing the loss from oat smut. The attempt has been to find efficient remedies, that may be readily applied. Bulletin 28 gave the best method known at that time, 1889, which was the use of blue vitriol applied to the seed. In 1891 Bulletin 35 gave details of the newly tested method of treatment with hot water, an excellent method still used by many practical men. Again in 1899 the station put out Bulletin

77 advocating the use of formalin for cleaning the seed and preventing smut. A more extended account of this method, giving much practical data, was issued in 1901 as Bulletin 87. This method has proved remarkably efficient, cheap, and easy of application, and comes as near to being an absolutely satisfactory process as any known for a fungus disease.

Method of Treatment.—It is a simple method, requiring no special precautions. *Sprinkle the seed oats with a solution of formalin of the strength of one pound of formalin to 50 gallons of water until nearly moist enough to pack in the hand, shovel into a pile and cover. After two hours or more the oats are ready to sow,* or can be spread out and dried and kept for future sowing.

Formalin is a gas dissolved in water, and the reason for covering the oats is to keep it confined and give time for the gas to penetrate between the chaff of the grain, and thus reach every spore of the fungus and kill it. After the spores are killed it is immaterial whether the grain is sown at once or dried and sown after a time. If sown without drying, a little more per acre should be used to allow for swelling.

The efficiency of this method has been fully tested and is beyond question. Its cost is about one and a half cents per bushel, or less, for the material. Formalin can be bought at almost any drug store. The time and labor required are not great, and the returns are ample. The trouble in setting about an unfamiliar piece of work is probably the greatest obstacle in the way of making this a regular farm practice for every thrifty farmer who grows oats.

Treatment on a large scale.—Two years ago an offer was made by Messrs. Caldwell, Barr & Co., of Benton County, to test the formalin method on a large scale, the work to be under the direction of the Station. This trial was carried out with much completeness, and gave satisfaction to both parties concerned. Messrs. Caldwell, Barr & Co. not only control a large acreage for seeding, but also operate an elevator, especially fitted with a device for purifying and aerating grain.

All the handling of the grain being done by machinery made it possible to apply the formalin treatment most expeditiously at the rate of 500 bushels per hour. Formalin was used of the strength of one pound in twenty-five gallons of water, and about 100

gallons of the solution used for each 500 bushels of grain. The cost of the formalin for this amount of grain is therefore from $1.20 to $1.60, according to the retail market price at the place of purchase, or about one-third of a cent. per bushel.

To carry out treatment in this manner it is necessary to have a vertical drop or chimney about three feet square and 40 to 50 feet high. On the inside of this drop are placed shelves or deflectors sloping downward, alternately on two opposite sides from top to bottom. As the grain drops from the top it is tossed from side to side as it strikes against the deflectors in its fall, and is thus thoroughly mixed. By means of a small steam pump the solution of formalin is thrown against the falling grain, near the top of the drop, in a fine spray. The rate at which the grain is allowed to flow determines the amount of solution applied per bushel. By the time the grain reaches the bottom it has been so agitated that the moisture is distributed with perfect uniformity.

The grain is allowed to remain in the bin at the bottom of the drop, or run into another bin, as may be most convenient, and after standing not less than two hours, or over night if desired, it can be taken to the field for sowing, or can be run again through the drop and this time dried out by a blast of cold air. After drying, the oats may be kept indefinitely or shipped. Oats thus treated are not injured for feeding, but if properly handled are even improved by killing deleterious germs other than smut spores.

The appliances used in this process are used in combination with principles invented by Messrs. Caldwell and Barr, of Earl Park, Ind., which were originally devised to apply fumes of sulfur and moisture with or without heat, in order to remove stains, kill germs, and otherwise purify and brighten various kinds of grain. Their inventions used in this process of purifying are covered by letters patent, but these do not in any way interfere with the use by anyone of the appliances and process for applying formalin only, in treatment of seed as outlined above.

In addition to the tests with formalin a trial was made with sulfur fumes and moisture at air temperature, according to the firm's special process, and beneficial results in preventing smut attained, but considerably inferior to the formalin treatment. The germinating power of the seed was also somewhat less satisfactory.

Although the sulfur process is not likely to supercede the formalin method as a direct means of preventing smut, yet it is interesting to know that seed properly treated by this improved method of purifying is partly, if not wholly cleaned of smut, and is valuable for seeding.

Tests in 1903.—The following record is made to show the grounds on which the above recommendations are based. The oats used for the tests were not especially selected, but were of the ordinary grade being handled at that time. Examination by the centrifugal process, devised by Professor Bolley of North Dakota, showed that the percentage of smut spores present was low, which was unfortunate from the experimental standpoint, as it gave less opportunity for a conspicuous and convincing demonstration.

On the 27th of March, 1903, three lots of oats were treated with formalin, and one with sulfur fumes, and were sown the same day, or the day following. It took approximately fifteen minutes for each treatment, although the work might be done somewhat more rapidly with the process well in hand. The *first lot* of 140 bushels received 25 gallons of the solution (strength of 1 to 50) containing about half a pound of formalin, which made the grain moist, but not enough to pack in the hand. It was run into a bin and left from 5 P. M. until 8 A. M. the next morning. It then appeared dry, all the moisture having been absorbed by the seed, and was at once sown. The *second lot* of 90 bushels received 16 gallons of the solution (strength of 1 to 50, containing about one-third pound of formalin, and a small amount of steam used in addition, which made the grain moist enough to pack slightly in the hand. It was run into a bin and left two hours, then dried somewhat with a blast of air at ordinary temperature, and at once sown. The *third lot* of 97 bushels received 20 gallons of the solution (strength of 1 to 25) containing about four-fifths of a pound of formalin, without steam, which made the grain about as moist as in the last lot so that it would pack slightly in the hand. It was not sown until the day following, when it was dry enough to be used in the seeder. The *fourth lot* was treated with sulfur fumes and a spray of water, both at ordinary temperature.

Tests in the laboratory showed that the number of germinations was somewhat reduced by the formalin treatment, the third lot,

which had the strongest treatment, a trifle more than the others, and that the germinations of the sulfur treated lot were somewhat lower yet. This reduction in germination is not, however, an unmixed evil, as it takes out chiefly the weak and imperfect seeds that would be of little benefit to the yield in quantity and none in quality.

LOT 1.

Treated at rate of 1 lb. Formalin to 280 bu. oats and left for 15 hrs.

		Per cent. germination	Number stalks counted	Number stalks smutted	Per cent. smutted
North field	Treated	93	3000	51	1.7
	Control	97	1500	54	3.6
South field	Treated	93	3000	45	1.5
	Control	97	3000	114	3.8

The treated lots were sowed in fields of thirty to fifty acres each, with a field of about the same size adjoining each one for untreated seed. As the first lot treated was much larger than the others, it was sown in two fields some distance apart with an untreated field be-

LOTS 2, 3 AND 4,

About 90 bushels of oats sown in each field.

Lot	TREATMENT	Per cent. germinat'n	No. stalks counted	No. stalks smutted	Per cent. smutted
2	Treated at rate of 1 lb. formalin to 270 bu.	93	3000	51	1.7
3	Treated at rate of 1 lb. formalin to 120 bu.	92	3000	9	.3
4	Treated with sulfur fumes	88	3000	61	2.0
Control	Untreated	97	1500	42	2.8

side each one as a control, and data taken independently for the different fields. It is interesting to note how uniform the data run for the smut in these parallel tests. The treatment was given on the twenty-seventh of March. A sample of each lot, amounting to a little over a pint, was taken to the laboratory of the station at Lafayette, from which 200 seed of each in duplicate sets of 100 were placed in a Geneva germinator for determining their vitality, and the remainder sown in the station garden. On July 8th the percentage of smut was determined in the plats at Lafayette, by counting 500 stalks of each treated lot, and twice as many of the untreated. On July 9th and 10th the percentage of smut in the fields at Earl Park was also determined by counting a still larger number of stalks over

SUMMARY.

Lot	TREATMENT	Per cent. germination	Per cent. smut in field	Per cent. smut in garden
1	Formalin too weak. Not enough moisture used. Helped by standing	93	1.6	1.2
2	Formalin too weak. Right amount of moisture used. Stood too short a time	93	1.7	1.8
3	Formalin strong enough. Right amount of moisture used. Stood 2 to 15 hours	92	.3	.0
4	Sulfur fumes	88	2.0	1.4
Control	Untreated	97	3.5	3.8

several areas in different parts of each field. These statistics of the amount of smut were taken by Mr. J. C. Marquis, an accurate and conscientious worker. The data are recorded in the several tables.

It will be noticed by consulting the last table, that the percentage of smut in the untreated seed is larger in the garden plats than in the field, and in the treated seed it is mostly smaller in the garden plats than in the field. This is what should be expected, because the small amount of seed used in the garden did not receive much handling and practically no spores were knocked off the grain in the

process of sowing, and also there was no contamination of the treated seed with untreated seed. In farm practice the more the untreated seed containing much smut is handled, the more spores are dislodged and blown away from the grain, thus slightly decreasing the amount of smut that develops. If this grain is put through a fanning mill or similar cleaning process, much more smut will be removed. But the amount of smut got rid of in such manner is only a small part of the whole amount on the seed. Again, on the farm when seed has been treated and the smut spores killed, there is likely to be some contamination from bins, wagon beds, bags, seeders, etc., used in handling this seed between treatment and its deposit in the ground, thus re-introducing a small amount of smut into the clean seed, unless unusual precautions are taken. This slight difference between farm practice and exact experience is well brought out in the last table.

It will be observed by examining the table of summaries that in the three trials with formalin, the first and second were faulty because the formalin solution was too weak, although a strength of one part of formalin to fifty parts of water is what has been found most satisfactory in farm practice where the work is done by hand. This is doubtless because some of the formalin is lost while the grain is thrown about in passing down the fifty foot drop. The third trial came very near being wholly satisfactory, because the formalin was used twice as strong. Possibly it was a little stronger than necessary, as evidenced by the slightly lower germinations, for we may doubtless credit the three-tenths of one per cent. of smut found in the field to contamination in handling the treated seed. But the results are exceedingly satisfactory, so far as one season's trial can be made.

Similar trials of the formalin and sulfur methods were made in 1904, but the much lower percentage of smut in the untreated seed, and the unfavorable season for the development of smut, prevented the work from bringing out any additional facts.

Conclusion.—A very rapid and inexpensive method of killing all smut in seed oats, and rendering the resulting crop practically free from smut, is to apply a spray of formalin, strength of 1 pound to 25 gallons of water (or somewhat weaker), using

about twenty-five gallons of the solution to one hundred and twenty bushels of seed, in the manner described above. Let the treated grain lie in a bin from two to fifteen hours after treating, before it is sown. If sowing can not be done at once, have the seed dried and kept for future sowing.

There are already a number of grain elevators in Indiana fitted with machinery for this work. Some of them will treat seed oats in this manner for any farmer without additional charge, and the expense in any case, will amount to little more than the time of going to the elevator, while the profit to the farmer may be considerable.

Purdue University

Agricultural Experiment Station

BULLETIN No. 104, Vol. XII

MARCH, 1905

A Simple Alkali Test for Ripeness of Cream.

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A Simple Alkali Test for Ripeness of Cream.

By H. E. Van Norman.

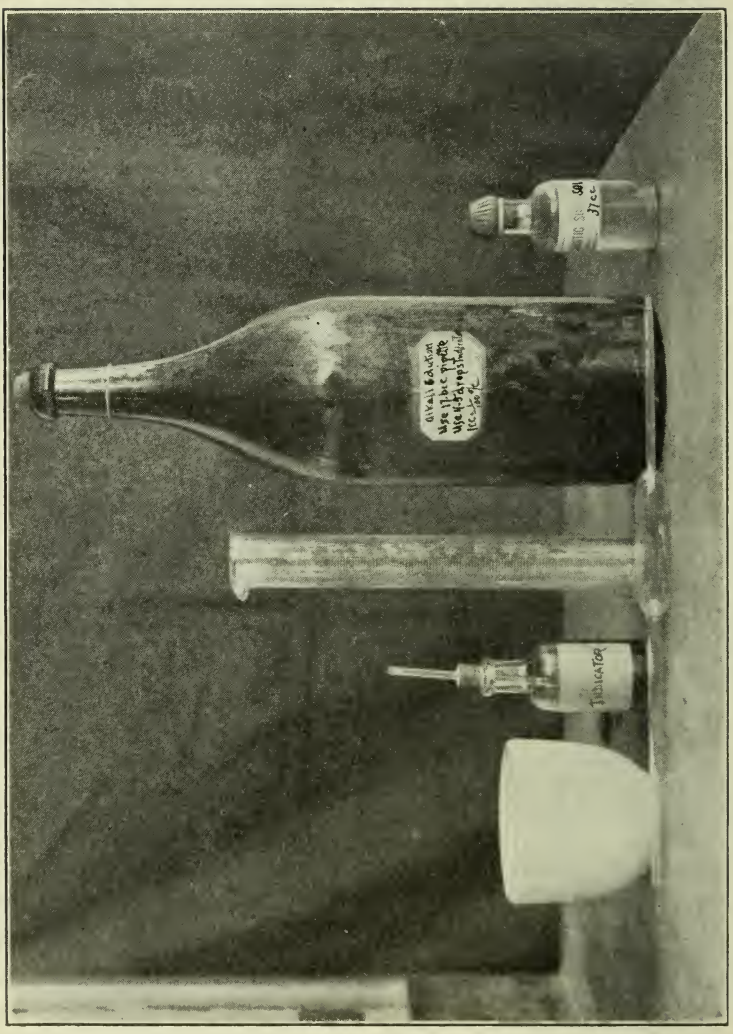
Visits at a good many Indiana creameries show but few of our buttermakers using regularly in their work the alkali test for determining the ripeness of cream. In several instances grocers using butter from Indiana creameries said that the chief fault was lack of uniformity in the product from week to week. These conditions together with the requests of students for information as to where the Purdue test could be secured, prompt the publication of the following description of it, and the further urging that our Indiana buttermakers use every means at their command to improve the quality and insure that uniformity which will command the top market price. There is no reason which cannot be overcome, why "State creamery" butter should not command as high price as "Elgin." In fact when the quality is there, in all probability it is sold as "Elgin."

This test is particularly adapted to creamery conditions. However, there is no reason why the dairyman who is making a considerable amount of butter, sufficient to justify the labor, should not become familiar with this test even though he may not use it regularly. If he is supplying a critical trade at a satisfactory price it is desirable to use every means to secure uniformity of product.

The Test.

During the ripening of cream the milk sugar in it is converted into lactic acid by bacteria. The measurement of the amount of acid developed during the ripening is the nearest approach we have to a measure of the ripeness of the cream. For this purpose Mann's acid test and Farrington's alkali test have been used with marked success. Where either one of these tests are regularly used, it is the almost universal experience that the quality of the butter runs more uniform, and loss of fat in the buttermilk is less than where the maker depends on his nose and his taste to determine the ripeness of the cream.

We have used in the Dairy school and the Station laboratory at Purdue, for a year and a half past, a slight modification of the tests on the market, which has simplified the work and contributed to accuracy of results.



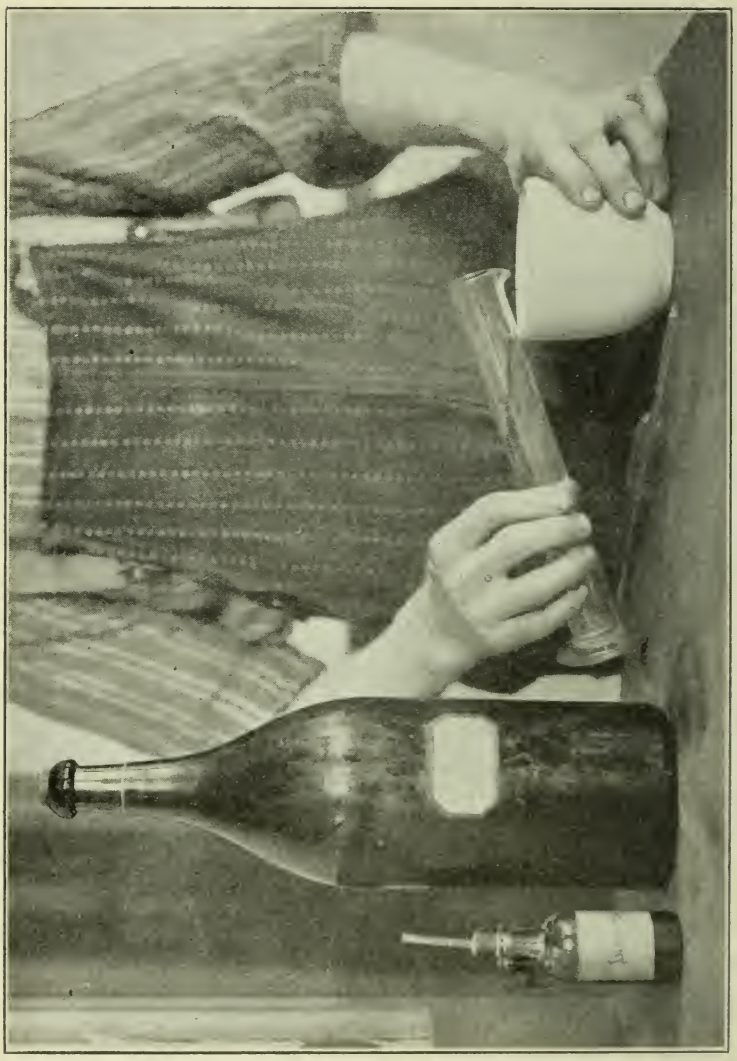
THE APPARATUS REQUIRED.

The apparatus required are a 17.6 cc Babcock pipette which should be found in every creamery with the Babcock testing outfit, a 100 cc cylinder such as is used with the Farrington test, a two quart bottle graduated at 1,850 cc., 37 cc of normal solution of caustic soda, accurately measured, and a small bottle, four or eight ounces, of Phenolphthalein indicator (a two per cent. alcoholic solution.) The caustic soda solution must be procured from a reputable chemical or dairy supply house which can be depended upon to furnish it of standard strength accurately measured. A two quart bottle, with a long sloping neck, such as is used for mineral waters sold at the drug stores, may be graduated by measuring into it carefully 1850 cc of water at a temperature of 60°, and then with a fine file marking the point on the neck to which the water rises.

To prepare the solution pour into this large graduated bottle 37 cc of normal caustic soda solution, rinse the little bottle, emptying this rinse water into the large bottle also, then fill with water. Condensed steam from the steam pipe, if it is free from boiler compounds and oil, should be used; if not, use rain water and fill the large bottle to the mark on the neck. This makes a 50th normal solution ready for use.

To Test Cream, Milk or Starter.

With a Babcock pipette measure into a white cup, or even a common composite sample jar, 17.6 cc of the cream to be tested, which has been well stirred; rinse the pipette out with clean water, putting the rinse water into the cream sample and add four or five drops of the Phenolphthalein indicator. Having filled the cylinder to the top or 100 cc mark with the 50th normal alkali solution, begin pouring slowly into the cream sample, mixing with a rotary motion of the hand or stirring with a glass rod until there is a pink color noticeable, which does not disappear immediately by continued stirring. Note the number of cc of the alkali solution required to bring about this result. This will indicate the number of 100th per cent of acidity, since 1 cc of the alkali will neutralize .01 per cent of acid when 17.6 cc of milk or cream is used. A cream under most conditions should be churned at an acidity somewhere between .55 and .70 per cent. of acid, depending on the richness of the cream and market requirements for flavor.



ADDING THE ALKALI TO THE CREAM AND MIXING THEM.

Cream that requires 66 cc to neutralize it is not appreciably riper than that requiring 64 cc. While in the case of the Mann's test, an error of 2 cc means a very appreciable variation in the ripeness of the cream.

Since the per cent of acid present in any cream is influenced by the part not fat and since this is influenced by the per cent of fat in the cream, the per cent of acidity required will vary with the percent of fat in the cream. We have adopted for our work in cream ripening the rule:—100 minus the test times .9 equals cc. of alkali required at churning time, (100 — test × .9 = cc.) the test being the per cent. of fat in the cream. For example.

If the cream tests 30 per cent we would have 100

30

70

.9

63.0 = cc. alkali

required to neutralize 17.6 cc. cream when it is ready to churn. In the case of cream testing 25 per cent fat we would have 100

25

75

.9

67.5 = cc. alkali

Therefore that cream would be ripened to .67 or .68 per cent acidity.

Each buttermaker must modify the above rule to suit his own market requirements, then prepare a table similar to the following which he can paste on the alkali bottle for ready reference:—

20 per cent cream requires .72 per cent acidity at churning.
25 per cent cream requires .67 per cent acidity at churning.
30 per cent cream requires .63 per cent acidity at churning.

If the above is too high, he may take .8 as much acidity as he has milk serum, i. e., 100 — per cent. fat × .8 = number of hundredths of a per cent. of acidity required.

The advantages which we have found in the use of this method are that the small bottles of normal solution do not lose their strength as long as they are left properly corked. Several may be ordered at a time, reducing cost of express and danger of breakage. The bottles measured out a year ago have not perceptibly weakened. The transportation charge on these small bottles is very much less than on the Mann's solution. The strength is more uniform than in the case of the Farrington tablets. In using there is less waste of solution pouring into the large cylinder than is usual where the burette is used. The larger amount of a weaker solution used reduces the per cent of error in the final results. The size of the bottle and the cylinder are more convenient to handle, the cost per test is less. There is no waiting for tablets to dissolve. It is ready as soon as it is shaken up, altogether making a more convenient test for factory use.

The confusion resulting from the use of two tests for the same work reporting the results in different terms has prompted the suggestion* that a uniform standard is desirable. It suggests the use of a 50th normal solution, which is in harmony with the practice in this laboratory for the past year and a half, and further suggests that butter makers having Mann's test have but to make up a solution with one part Mann's solution and four parts distilled water, which may be secured from the steam pipe, or rain water may be used. This solution will be equivalent in strength to a 50th normal if the Mann's solution was right, and with a graduated cylinder such as described above or a burette will enable the butter maker to report the results in per cent of acidity, since 1 cc of this solution will measure .01 per cent of acid when the cream is measured with a Babcock pipette.

It is recommended that the acidity of cream be reported in per cent, as being better for comparison and more convenient.

To Grade Cream.

In spite of the reluctance of many creameries to receive cream from the hand separators, the amount of butter made from such cream is increasing quite rapidly. The increased value of the skim

*New York Produce Review, June 8, 1904, page 210.

milk for feeding purposes, the every other day delivery of cream, the greater convenience to the farmer, all combine to make him want the hand separator, rather than the delivery of his whole milk to the creamery.

If the cream has been as well handled as the whole milk, as good butter can be made. The objection is not that the cream cannot be delivered in as good shape, but that it is not. The creamery that receives hand separator cream is confronted with the problem of getting a cream of that quality which will enable it to make first-class butter.

While it is not a cure-all for the situation, it has been found a great help to grade the cream, and pay less for that which falls below a certain standard, arriving sweet and free from objectionable taints.

To determine the sweetness the alkali test may be used with marked success. For pasteurizing purposes it is considered that milk must not have over .2 of one per cent of acidity. This same standard may be adopted in cream grading, and any cream having over that amount may be classed as second grade.

For the sake of illustration we will use .2 per cent as the standard. In the weigh room on a convenient shelf, arrange an extra set of pint or half pint sample jars, as many as are needed for the number of lots of milk or cream which it is desired to test for acidity. Before the morning arrivals begin, measure into each of the jars 20 cc of the 50th normal alkali solution described on previous pages, and add three or four drops of the indicator. This will give an alkali solution of a bright pink color. Have near some clean distilled water, or rain water. When the first lot of cream arrives, which it is desired to test, after emptying into the weigh can and thoroughly mixing, draw a Babcock test pipette (17.6 cc) of the cream, and put it into the first jar. Draw some of the clean water into the pipette to rinse the cream down which has adhered to the inside of the pipette, putting this rinse water into the sample jar with the cream. Having done this give the jar a rotary motion and thoroughly mix cream and alkali. If the color remains pink, there is not enough acid in the cream to make the .2 per cent. If, on the other hand, the color all disappears, there is more acid than .2 per cent. and the cream would not be accepted as sweet.

Any standard of acidity may be adopted that the experience of the creamery dictates.

To measure the alkali into the jars the regular cylinder may be used, or if the pipette is one of those with a fairly large diameter and the 17.6 mark down close to the bulb, 20 cc may be measured into it carefully and with a file it can be marked; then the alkali can be measured into the jars with the pipette and the same one will do for both; remembering that the number of cc of alkali used for 17.6 cc of cream represents the per cent. of acidity.

The small amount of cream required makes this an inexpensive test. Placing the question of sweet or sour on so nearly an exact basis, rather than entirely on the judgment of the man weighing in the cream, often has a very helpful influence on the mind of the patron in convincing him that there is really a difference between the cream which he is bringing, and that which is wanted.

It will usually not be necessary to test all the cream received each day, especially after it has been done regularly for some time.

Table of Comparison.

Reading of Mann's Acid Test		Per cent. by Purdue or Farrington
20 cc	equivalent to	.36 per cent.
21 "	"	.38 "
22 "	"	.40 "
23 "	"	.41 "
24 "	"	.43 "
25 "	"	.45 "
26 "	"	.47 "
27 "	"	.49 "
28 "	"	.50 "
29 "	"	.52 "
30 "	"	.54 "
31 "	"	.56 "
32 "	"	.58 "
33 "	"	.59 "
34 "	"	.61 "
35 "	"	.63 "
36 "	"	.65 "
37 "	"	.67 "
38 "	"	.68 "
39 "	"	.70 "
40 "	"	.72 "

Purdue University

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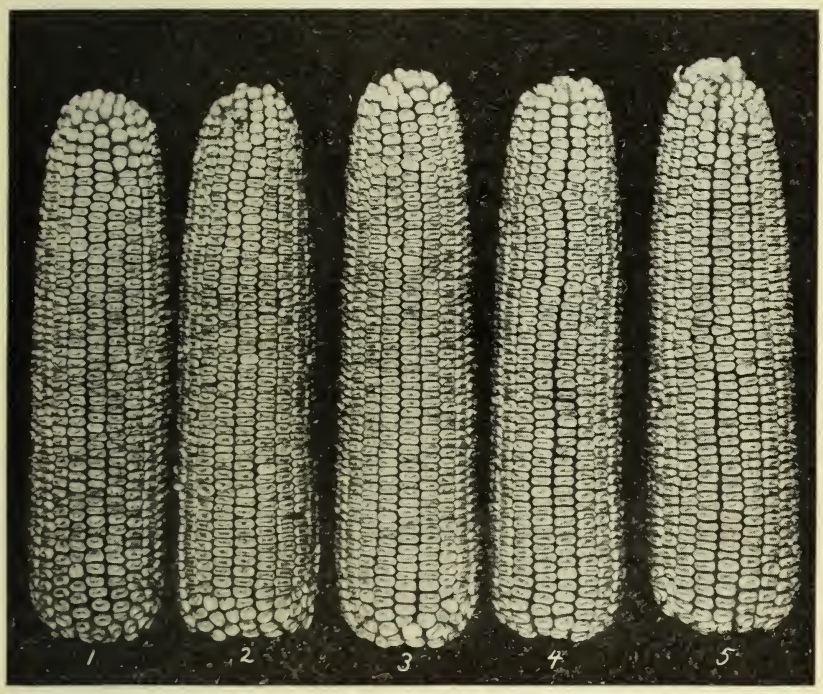

BULLETIN NO. 105. VOL. XII.
MARCH, 1905.

Corn Improvement in Indiana

Published by the Station:
LAFAYETTE, INDIANA.
U. S. A.

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Corn Improvement in Indiana

By A. T. Wiancko.

It is gratifying to note on every hand that the farmers of Indiana are rapidly taking a greater interest in the improvement of their corn. Questions are constantly being asked as to methods of improvement and where good seed of improved varieties can be secured. That many farmers are now willing to pay good prices for good seed corn is a healthy sign.

Corn is undoubtedly the king of grain crops throughout Indiana. The crop of the year 1904, for this state, amounted to the magnificent total of 143,396,852 bushels, representing a money value of over $60,000,000 for the grain alone. Over 4,000,000 acres of the best lands in the State are annually planted to corn. The average production during the last ten years on this area has been about 33 bushels per acre. This is very much smaller than it should be. Experiments now in progress show that the average yield might easily be very materially increased by a combination of more careful seed selection, better cultural methods, and proper attention to the maintenance and improvement of the fertility of the soil.

The prospects for improvement are very bright. Our farmers are awakening to a belief in the possibilities, and are beginning to make an effort in the right direction. We could point to quite a number of farmers in the State, working on average soils, who are producing 60 to 75 bushels per acre every year, and their methods are not yet by any means as good as they might be. Large areas of the better lands are capable of producing, and some are producing, even with comparatively poor methods, 80 to 100 bushels per acre.

There is no crop that is more responsive to more careful selection of seed and better methods of treatment generally than is

corn. A difference of five to ten bushels per acre in productiveness is easily made, and the crop of the State could easily be increased by several millions of bushels in a single season without increasing the acreage, and at practically no greater expense. Our conditions for corn production as to soil and climate are, for the most part, excellent and there is no adequate excuse for the low average yields. If every farmer would make a little effort, wonderful improvements could be quickly produced. There is little danger of over production. The markets of the world are large and the uses to which corn are put are constantly growing and increasing.

Any effort at corn improvement must be based upon proper methods of breeding and seed selection, as well as careful field culture. Better seed will go a long way towards producing larger yields. In the following pages an effort will be made to describe and discuss practical and easily applied methods of improving the yield and quality of corn, so far as this is dependent upon better seed.

I. THE SELECTION AND PREPARATION OF SEED CORN.

The importance of selecting good seed corn, taking good care of it, and preparing it well for the planter cannot be overestimated. Experments have shown that well bred and cerefully selected seed corn, of a type suited to the soil and climatic conditions where it is to be used, will produce from ten to one hundred per cent more corn per acre than the seed corn at present used by the average farmer. Rich soil and good culture are important factors in producing a large crop of corn, but good seed will add very considerably to the yield. Our farmers are gradually awakening to a realization of this fact and many have already materially increased their yields by greater attention to the quality of the seed they use.

Time and Methods of Gathering Seed Corn.

To get the best seed corn it should be selected in the field after it has matured and while the characters of the parent stalk can be observed. This can be done to the best advantage by going through the field after the corn is mature and before the general harvest begins and picking ears of good size and quality from the stalks that are strong and vigorous looking, but not coarse. There should be a large leaf development. The leaf is the laboratory of the plant where the food it gathers is manufactured. The stalk should be of medium size, strong at the base and tapering gradually to the tassel. It should stand up well and bear its ear at a convenient height for husking. The shank should be of medium length and strength. A short shank holds the ear too erect, while a long shank allows it to hang over too far. Ears on long shanks or high up on the stalk are more likely to pull down the stalk during a wind storm, besides being inconvenient to husk. The ears selected should be strong and well developed, with straight rows of regular sized kernels (see illustrations). The kernels should be rather deeply dented. The smoother kernels are generally shallower and will not produce so well. The seed ears should always be a little rougher than the average of the crop, otherwise the variety will become smoother each year and the kernels shallower.

Seed corn should never be picked before it is mature. An immature kernel has not had time to store up all the food it wanted and consequently will be more or less weak in vitality. Early picked corn, if well preserved, may germinate well under favorable conditions, but its constitution has been weakened and the yield will be correspondingly lessened. Nature should be allowed to ripen the seed in her own way.

Selecting seed corn from the crib is always objectionable. The vitality has generally been more or less injured, and, while the ears selected may have a good appearance, one can tell nothing as to the character of the stalks which produced them. Numerous experiments have shown that crib corn produces smaller yields than corn that has been properly selected in the field and well preserved through the winter.

The quantity of seed corn selected from the field should always be considerably more than will be needed for planting so that there may be room for further and more critical selection later on. If the quantity of seed ears selected before the general husking is insufficient, it is a good plan to have a small box attached to the outside of the wagon box into which desirable seed ears found while husking can be put.

The Preservation of Seed Corn.

Much corn that is intended for seed is injured by improper methods of drying and storing. It is most liable to injury during the first month or six weeks after husking. As it comes from the field it still contains twenty-five or more per cent of moisture, and as this moisture is contained within the kernel and cob it takes considerable time to get rid of it, unless artificial heat is applied.

It should be stored at once in a *dry, well ventilated* place, and in such a way that there may be a free circulation of air around each ear. If this is not done its vitality is almost sure to be injured, either by moulding, fermenting, growing or freezing. There are many methods of storing seed corn, but in all cases the place of storing must be dry and well ventilated. Seed corn should always be stored in the ear. It should never be put into boxes, barrels or sacks. In some cases it is successfully kept in the cellar under the

house, but few cellars are dry enough for the purpose. The attic, or an empty room upstairs in the house, is a good place for storing if it is not too warm and close while the corn is still moist. The barn and crib are suitable places for storing if there is time enough for the ears to become thoroughly dry before freezing weather comes. The amount of freezing seed corn will stand depends entirely upon its dryness. If thoroughly dry and surrounded by dry atmosphere it will stand very cold weather.

No matter where it is stored it should be either hung up or placed on racks made of narrow strips with spaces between. A specially constructed seed corn room is, of course, desirable and should be provided whenever possible, especially if a considerable amount of seed is to be stored. Such a house should be set upon posts a couple of feet above ground so that air may circulate freely underneath. It should also be made mouse proof by placing inverted galvanized iron pans upon the posts upon which the building rests. The structure must be of such a nature that a free circulation of air can always be secured. The inside should be fitted with racks, not ordinary shelves, upon which to place the corn. These racks may be made by setting a row of uprights, six inches wide, several inches out from the wall at intervals of about four feet, securely fastened to the floor and to joists above. A narrow cross piece is then nailed on each side of the row of uprights, several inches above the floor, upon which to lay a double row of ears. Above this two more strips are nailed for a second double row of ears, and so on to a convenient height. The next rack should be placed far enough away from the first so that a man may conveniently pass between. The third one may be placed about six inches from the second. Then another passage should be left, and so on across the room. Such a seed house need not be expensive and will soon pay for itself by the better quality of the seed corn stored in it. The house should be provided with a stove in which a slow fire may be kept during damp weather. Where a separate seed house can not be provided, racks similar to those discribed above may be constructed in any building where the corn can be kept dry.

While it is a good plan to have a stove in the seed house for use in damp weather, fire drying of seed corn should not generally be practiced. It is always more or less risky on account of the danger of over-heating while the corn is still moist. Natural drying, if there is time for it, is always safest.

Buying Seed Corn.

Seed corn should always be purchased in the ear. For this there are at least three important reasons. First, the purchaser can see exactly what he is getting, and the corn is likely to be of much better quality. Dealers always select the better ears to supply the customers who demand ear corn. Second, the vitality can be more thoroughly tested and the poor ears can be detected and discarded. Third, the seed can be better prepared for the planter by more thoroughly discarding the ununiform kernels. Ear corn usually sells for double the price of shelled corn and there is good reason for it. Only a small proportion of the ears in a wagon load of corn are good looking enough to sell for seed in the ear. The ten best ears in a bushel of corn, as it comes from the field, are worth more than all the rest for seed purposes. The farmer who has purchases his first lot of seed corn in the ear is apt to be dissatisfied with its appearance. He is apt to expect show ears. He should remember, however, that there are but few show ears in a wagon load of corn and they are worth very much more than he has paid for what he got.

As a rule it is not wise to import seed corn from a distance, because it may not be adapted to the conditions where it is to be used. If a farmer can get good seed from his own crop, or from a neighbor, it will usually give better results than imported seed. When it *is* necessary to import seed, or a different variety is desired, it should be secured from a place in the same latitude. When one goes south for seed corn he is apt to get something that will not mature in his locality and if he goes north he is likely to get something that is earlier than necessary and too small. As a rule, every degree north or south of a given point means eight or ten days difference in the time of ripening. Going east or west makes much less difference. Seed corn brought from a distance will usually take

two or three years to accustom itself to the new conditions before it will give the best results, no matter how good the seed may be. On this account only small quantities should be imported.

If seed corn must be purchased, the price should be least considered. The quality and purity of breeding are the important factors to be taken into account, as there may easily be a difference of several bushels per acre in its yielding power. The seed that will yield five bushels more per acre is easily worth $10 more per bushel. Many experiments have proven that the quality of the seed may make a very much greater difference than this.

Much of the seed corn sold by so-called seed corn dealers is nothing more than crib corn. This state of affairs can be remedied only by the purchasers insisting on being supplied with corn on the ear, and accepting it only after they have satisfied themselves as to its quality and germinating power. All honest dealers will guarantee their corn. There are a number of good dealers in the State who breed their own corn, and these men deserve to get a good price for what they offer for seed.

The Final Selection of Seed Ears.

In spare time during the winter, or at least several weeks before planting time, the farmer should go over his seed corn carefully and cull out the poor ears. The best of the best should be laid aside for the best field. A good way to proceed is to first select the single ear that most nearly represents the type wanted, as to shape of ear and character of kernel, and then, with this ear in one hand, the others should be compared with it, one at a time, until a sufficient number have been selected. To facilitate this work a table of some kind should be provided,—a single board will do,—upon which the ears may be laid a row at a time. Plenty of time should be given to this operation. A lover of good corn will find the work very interesting and the profitableness of it cannot be over-estimated. After this careful selection the ears are ready to be tested for vitality.

Testing the Vitality of Seed Corn.

No farmer can afford to neglect the simple vitality test. Many a field has to be planted a second time on account of imperfect ger-

mination, and very often a poor stand is allowed to remain or is patched up by replanting odd hills by hand, which is often labor thrown away, except for the fodder, because replanted hills, seldom produce perfect ears, there being insufficient pollen to properly fertilize them.

No one can pick out all the ears of imperfect vitality by a mechanical examination. Most farmers have learned this from the experience of the last two years. It is easy to pick out the ears that are visibly injured, but there are many cases of destroyed or weakened vitality that cannot be seen, even by the most expert examiner. Every weak germ means a weak plant and a small yield. Nearly every corn field will show many hills with one or more weak plants. These are nearly always directly due to weak germs.

There are many simple methods of making the germination test, but in all cases each ear should be tested by itself. Experiments have shown that as a rule the testing of a few kernels picked at random from different parts of the ear will safely determine whether or not the ear should be used for seed. About five kernels should be taken from each ear and kept separate, and the ear from which they came must be marked or placed in such a way that it can be readily located after the test is made. In selecting the kernels for the test, take one from near the butt, three from various parts of the middle portion and one from near the tip. Look for elevated or swollen spots on the ear from which to take the kernels. If there are any weak germs, they are likely to be found on the swollen spots, because there the cob was probably more or less spongy and retained moisture after the rest of the ear was dry and out of danger of being injured.

The requisites for germination are moisture, warmth and air. Any chamber or vessel in which these can be provided will answer the purpose. The exact method employed will be largely a matter of convenience. An ordinary dinner plate with a double fold of moistened muslin between which the kernels can be laid, covered with another plate to prevent too rapid drying, makes a very good germinating chamber. A shallow box into which several lots of kernels may be laid between folds of moistened paper and covered with a lid will do. A shallow box containing moist earth, sand, or

sawdust in which the kernels may be planted may also be handly. In any case the tester should be put in a warm place, but not too near the stove. The temperature of the ordinary living room is about right, provided that it does not become colder than 55 degrees during the night.

A convenient tester can be made as follows:—Take an ordinary bread baking pan of large size and fill it with clean sand or sawdust. Then take a long piece of strong cord or light wire and wrap it tightly around the pan at intervals of about an inch and a half, crosswise and lengthwise, thus marking off the surface into inch and a half squares. The squares may be more permanently marked off by fastening the cross wires securely into the sides and ends of the pan or tray, or by making a galvanized iron cover with perforations of the required size. Into each of these squares the kernels of a single ear may be planted, thus enabling the operator to keep each lot separate and easily locate them. The kernels need not be completely burried. Ordinary soil may be used instead of the sand or sawdust, but the latter are clearner to handle. Instead of the baking pans a shallow tray of boards may be made and fitted with the cross wires as described. A tray two by three feet in size will be large enough to make individual ear tests of about five bushels at one time. If much corn is to be tested, several of these testers should be provided. Some convenient system of arranging the ears on a floor, table or shelf must be employed, so that the ear corresponding to a certain square in the tester may be readily located. The material in the tester should be kept thoroughly moist, but not wet, and when the kernels have been placed, the whole should be covered with a cloth or gunny sack to prevent drying of the surface.

The tester should be placed in a room ranging around 70 degrees F. in temperature, as stated above. All kernels which do not send out vigorous root and stem sprouts within *five days,* under these conditions, should be considered as too weak to germinate properly under ordinary field conditions. If the germination of any lot of kernels is unsatisfactory, the ear from which they came should be discarded. About 95 per cent of the kernels should germinate strongly within the five days.

Preparation for Planting.

After the seed ears have been properly selected and their vitality tested as above described, they are ready to be shelled and the grain prepared for planting. The small and irregular kernels at the tips of the ears and the large irregular ones at the butts must be shelled off and discarded. Irregular kernels in the body of the ear should also be discarded as completely as possible so that only those kernels which are of uniform size and shape may go to the planter. This is very important, because it is impossible for a planter to drop uniformly the required number of grains per hill if they are not of the same size and shape. A uniform stand of plants can be secured only when the seed is uniform. Many a poor stand of corn is due solely to ununiform seed. It would surprise most farmers to learn how imperfect the stand is in their best fields. One has to count the missing hills on an acre, and those that have less than the required number of plants, to learn the truth.

It is a good plant to use a set of screens of two sizes through which to pass the shelled corn, discarding that which is retained on the larger and that which passes through the smaller. The grain should then be spread out thinly and carefully examined for broken, mouldy or otherwise damaged kernels, which must be picked out by hand. When seed of ununiform size must be used it should be graded, by means of sieves, into large, medium and small sizes, and a suitable planter plate used for each size.

When one considers how easily a difference in the yield of several bushels per acre may be caused by the character of the stand, he will readily see the wisdom of spending a little extra time in preparing the seed. A couple of hours spent in picking the ununiform, rotten and broken kernels out of a bushel of seed may earn several bushels of corn. The observing farmer will soon learn that he may easily earn dollars for hours spent in preparing his seed corn.

Testing the Planter.

After the seed corn has been perfectly prepared there is still one more important thing to be done, and that is to test the planter and make sure that it will drop the required number of kernels at

least 95 times out of a hundred. The planter should be set up on a clean floor or on some boards and operated by hand, using plates with different sized openings until the pair is found that will drop the desired number of kernels every time, if possible. Most up-to-date planters are supplied with a sufficient number of plates of different sizes so that it is only necessary to select the right set for the corn to be planted. If the plates do not quite do the work as required, they must be filed or drilled until they will. Generally a very little of such adjusting is all that will be necessary to give a perfect stand of the desired number of plant per hill. A poorly adjusted planter may easily offset the advantages to be derived from well selected seed and, therefore, this simple testing and adjusting should never be neglected.

Planting and Cultivation.

It is not the purpose in this bulletin to discuss the subject of field culture of corn. The preparation of the soil, proper fertilization and general field treatment of corn are subjects large enough to require a separate bulletin and will be treated fully at some future time. Well selected seed is only one factor in profitable corn raising.

As a rule, corn should be planted in hills, or check-rowed, if only for the reason that it may be better tended by cultivating both ways. No definite rule can be laid down as to the thickness of planting. The best distance between rows and the number of stalks per hill, or the distance between stalks in drills, will vary with the size of the variety and the character of the soil and climate. Under average conditions, with an average sized variety, about ten thousand stalks per acre will usually give the best results. The richer the soil the thicker may be the planting and the larger the variety the thinner it should be. The best thickness must be determined by each farmer for himself.

The ground should be deeply and finely prepared before planting. No amount of cultivation after planting can make up for a poorly prepared seed-bed. Cultivation should be thorough from the beginning of growth until the tassels appear, and frequent enough to keep a clean, fine, loose mulch of earth, two to three inches

in depth, on the surface throughout the season. Before the corn is large enough for the ordinary cultivator a light harrow or weeder, which will break any crust that may have formed and kill small weeds, should be used. The first and second times over with the regular cultivator should generally be deep, but subsequent cultivations must be shallow so as not to disturb the roots. It should never be necessary to use a large shoveled cultivator. The small shovel stirs the ground more completely and leaves it more level, causing less evaporation of moisture. After the corn is too high for the two-horse cultivator a one-horse implement should be used. The corn field should never be "laid by" before the tassels appear.

Types of Ears and Kernels.

The following photographs of ears and kernels were prepared with a view to serving as aids in the selection of good seed corn. They illustrate desirable and undesirable types of ears and kernels, not in a glaring way, but in such a way that with a little study good and poor seed corn may be recognized.

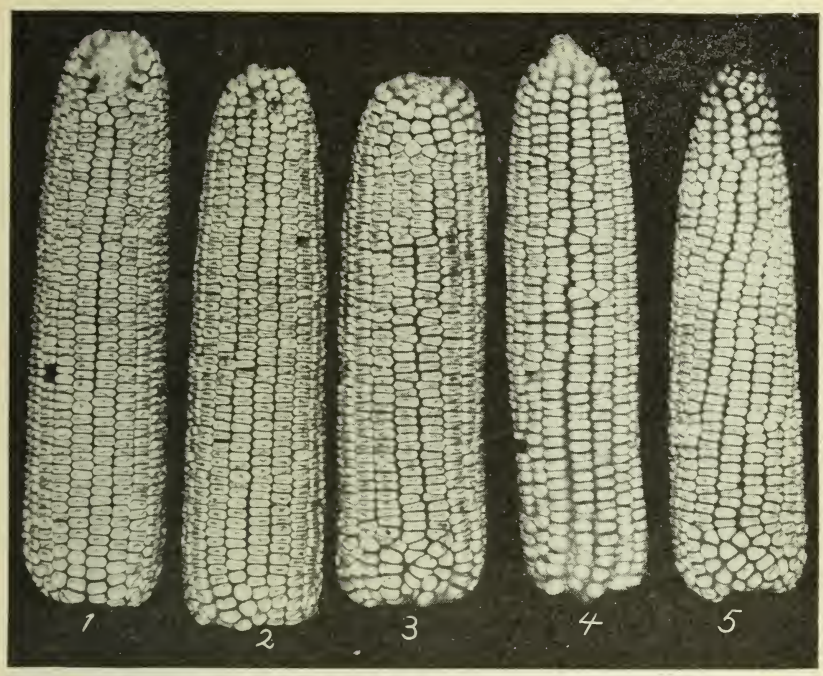

FIG. 1.

GOOD AND POOR SHAPES OF EARS.

A perfect ear of corn should be full and strong in the middle portion, indicating a strong constitution. It should retain its size to near the tip, giving a large proportion of corn to cob. The kernels should also retain a uniform size and depth to near the tip, and the rows should be straight. The tip should taper but slightly and then round off in a neat oval.

Ears 1 and 2 represent ideal forms. They are well proportioned and strongly developed.

Ear No. 3 is too heavy and blunt at the tip, indicating coarseness. It is also somewhat depressed or weak near the butt.

Ear No. 4 is decidedly weak and imperfect at the butt, denoting a weak constitution.

Ear No. 5 is too tapering and the tip is too pointed, showing weakness. The kernels towards the tip are shallow, rounded, and ununiform with the rest of the ear. The proportion of corn to cob is relatively small. Ears 3, 4 and 5 are all undesirable for seed.

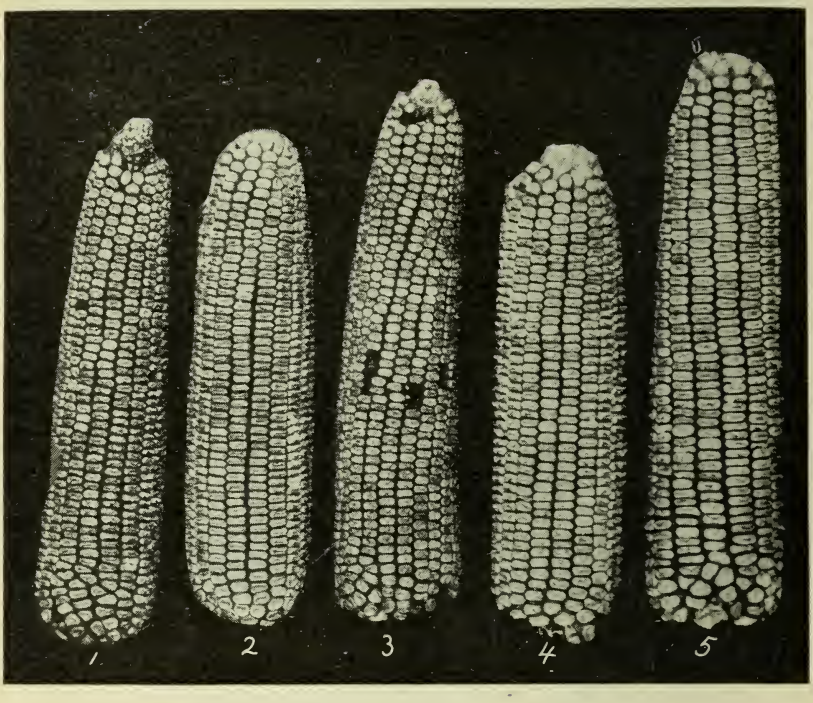

FIG. 2.

DIFFERENT SIZED KERNELS.

The above cut shows wide variations in size and type of kernels. They are so different in size and shape that if shelled together for seed no planter could possibly drop the same number of kernels per hill. Ears 2 and 4 would go together very well, but otherwise no two would do for the same lot of seed. The kernels on ear No. 5 are much too large for any dent variety, while those on ear No. 3 are rather small, besides being more or less ununiform.

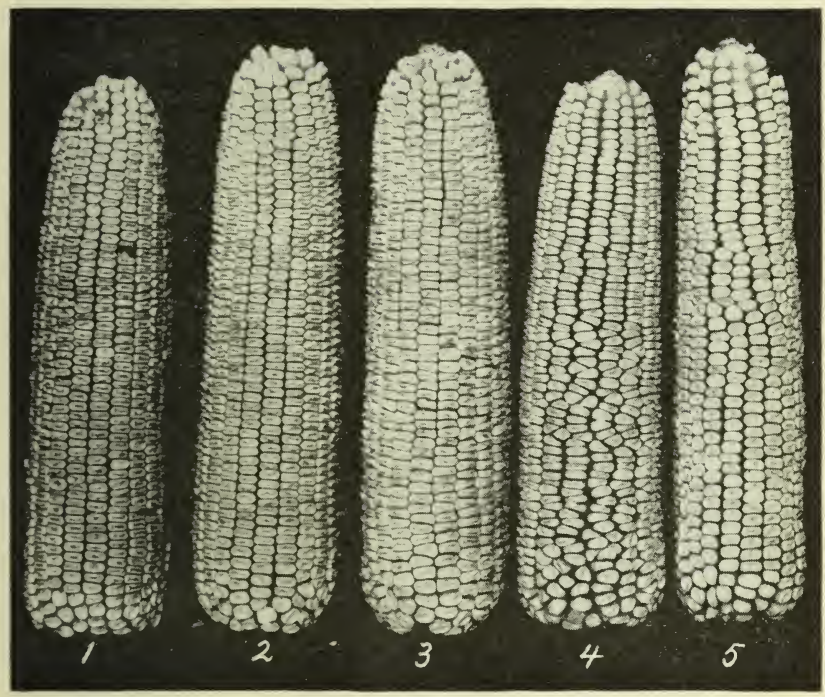

FIG. 3.

UNIFORM AND UNUNIFORM KERNELS.

The kernels in a good seed ear should be uniform in size and shape throughout the ear, and all ears to be used together should have similar kernels.

Ears 1 and 2 have fine types of kernels, of very uniform size and shape.

Ear No. 3 has a good form, but is not a good seed ear. A close examination will show that the kernels are, many of them, weak and of ununiform shape, varying much in thickness.

The kernels of ear No. 4 are much too irregular in shape.

Ear No. 5 has several broken rows. The kernels are too thick and also otherwise ununiform.

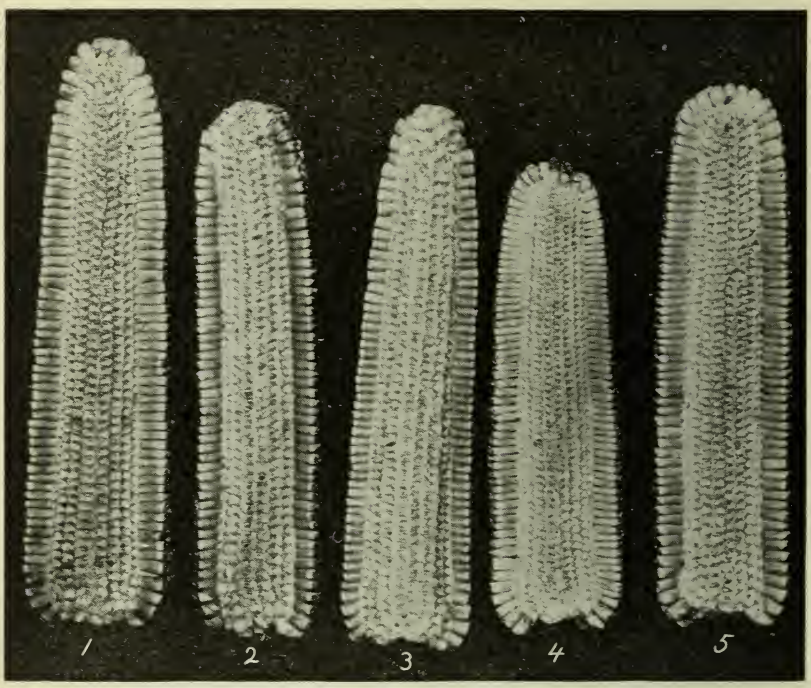

FIG. 4.

GOOD AND BAD SPACING OF KERNELS AT THE COB.

The kernels in the rows, as well as the rows of kernels, should fit closely together at the cob, showing a full, strong development. Wide spaces are often found and are due to shrunken or pointed tips. The tip end of the kernel should be strong and full, giving room for a large, deep germ. Since the germ is largest at the tip of the kernel and contains a large per cent of protein and nearly all the oil, a strong tip is essential to a high feeding value.

Ears 1 and 4 show wide spaces between the kernels at the cob, No. 4 being particularly bad. The tips of the kernels are very much shrunken, of poor vitality and low feeding value. Such space is very objectionable. Both ears look good from the outside.

Ears 2 and 3 are fairly perfect, the kernels fitting closely together from tip to crown. Ear No. 5 is also fair, but shows quite a number of small spaces at the cob.

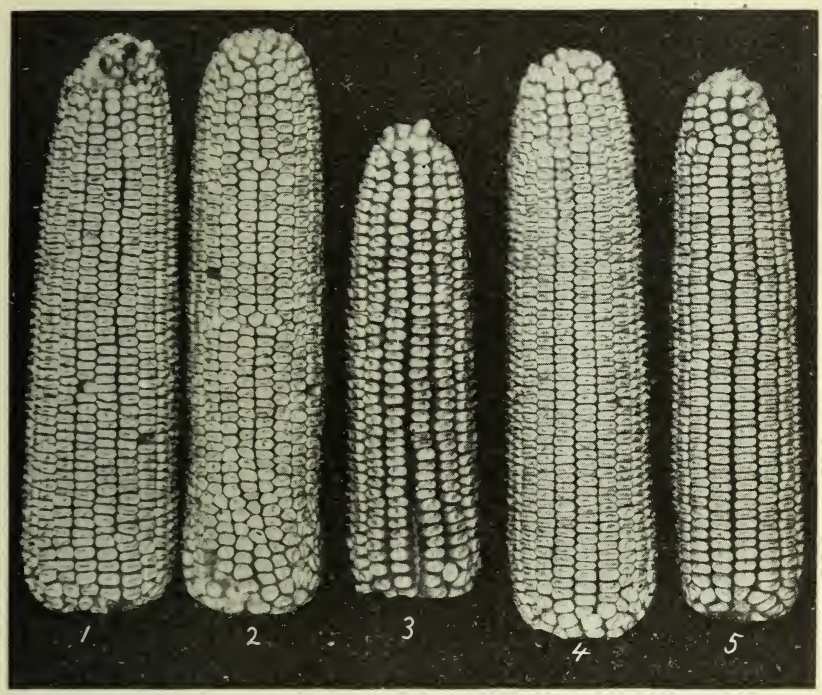

FIG. 5.

FURROWS BETWEEN ROWS.

The edges of a well shaped kernel should be almost straight, and the rows of kernels should fit together fairly closely. The furrows should be merely wide enough to admit air to facilitate drying. The spacing at the crowns may be too close, especially in large ears, making them dry too slowly and liable to mould.

The furrows on ear No. 3 are far too wide, indicating a small proportion of corn to cob. The furrows on ear No. 5 are also too wide.

The rows on ear No. 2 are rather close together and in places the kernels have pinched each other out of the cob.

Ears 1 and 4 are very nicely spaced.

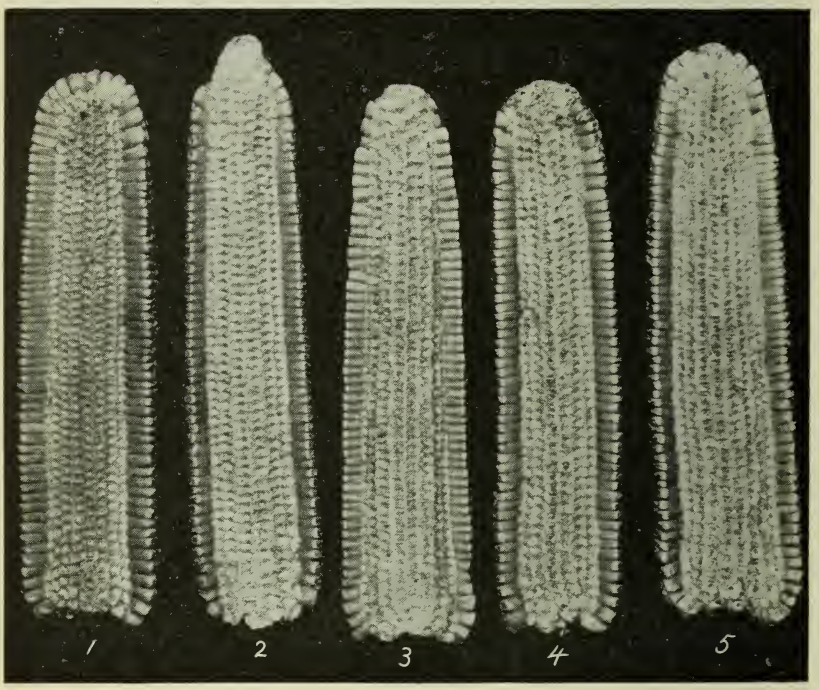

FIG. 6.

DEEP AND SHALLOW KERNELS.

The kernels should be deep throughout the length of the ear, as shown in ear No. 1. It is, however, possible to have too small a cob, which would indicate a weakened constitution and small yielding power.

The kernels on ears 2 and 5 are too shallow, showing too small a proportion of corn to cob.

The kernels on ear No. 3 are too shallow near the tip, while ear No. 4 is fairly good and ear No. 1 is excellent.

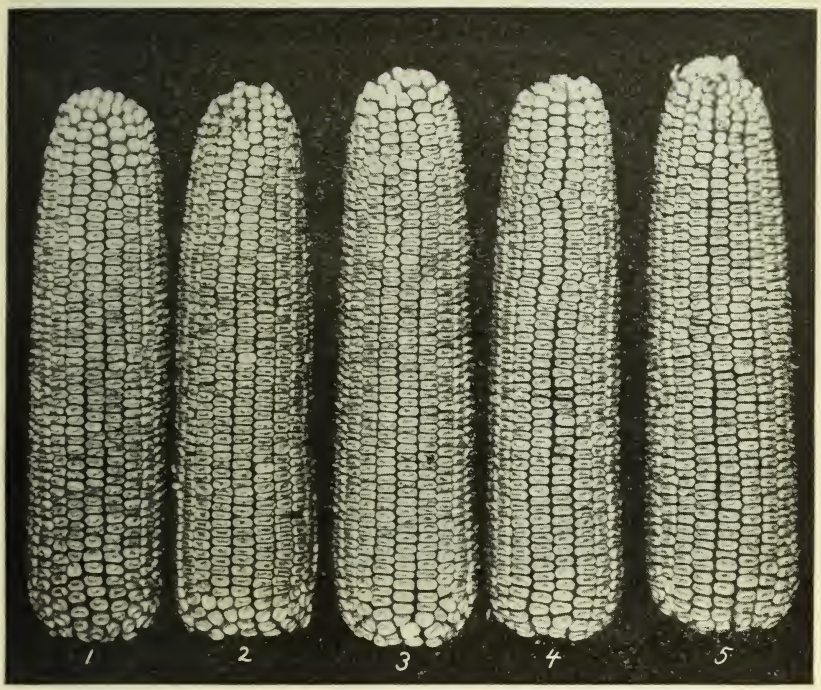

FIG. 7.

FIVE GOOD EARS.

Fig. 7 shows five ears that are almost ideal in type and uniformity. They need no apology.

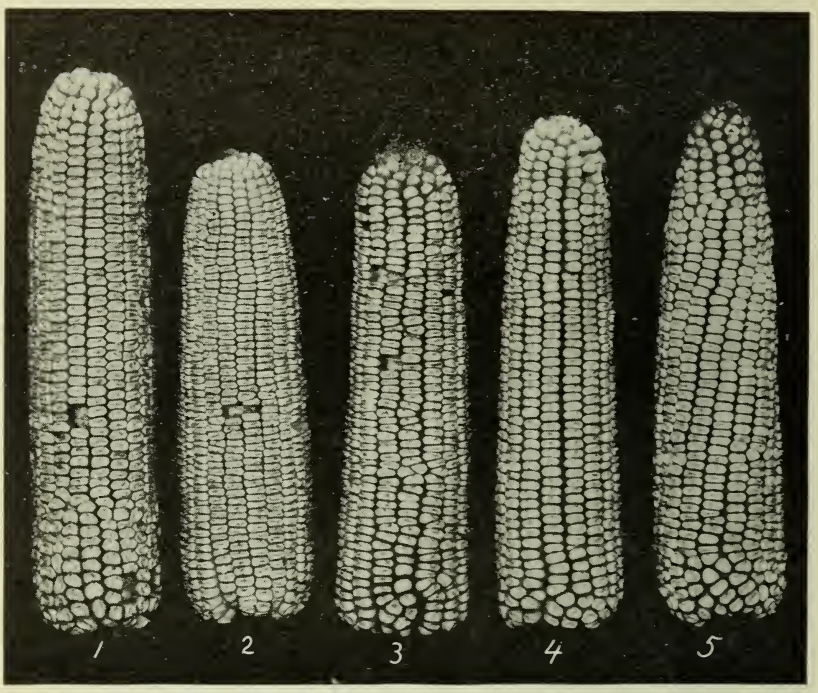

Fig. 8.

Five Poor Ears.

All of the ears in the above cut are undesirable for seed purposes.

Ear No. 1 is weak in development a short distance above the butt and the kernels are too thick and irregular in shape, besides being rather smooth and shallow.

Ear No. 2 is very objectionable on account of its weak, chaffy, shrunken kernels.

Ear No. 3 is fairly strong in type but its kernels are too irregular.

Ear No. 4 has kernels that are too much rounded on the edges, rather smooth and much too shallow, showing a small proportion of corn to cob.

Ear No. 5 is much too tapering and poined, besides having a large proportion of ununiform kernels.

FIG. 9.

VARIOUS TYPES OF KERNELS.

No. 2 is an excellent pair of kernels, and 4 and 5 are also good. No. 1 is rather pointed and rounded on the edges. Pairs 6 and 12 are much too pointed and weak at the tips. No. 3 is much too large. Pairs 8, 10 and 11 are too short and rounded, No. 10 being particularly poor in shape. No. 7 is thin and chaffy, and No. 9 is too narrow.

A good kernel must be full and strong at the tip, giving room for a large germ, which is essential to strong vitality and high feeding value. The edges should be nearly straight, but they must converge towards the tip sufficiently to allow the rows to fit closely together. In other words, the kernel should represent the thick end of a wedge in shape. A good kernel must also be of uniform thickness from crown to tip. The right hand kernel of pair No. 2 is almost ideal in size and shape for a medium sized dent variety, measuring a strong five-sixteenth of an inch in width, five-eighths of an inch in length and nearly one-sixth of an inch in thickness.

FIG. 10.

IMMATURE AND DAMAGED KERNELS.

A mature kernel should have a clean tip, a uniform color on back and front, a smooth, full germ, and a fresh, glossy appearance.

Pair No. 1 has chaff and bits of cob adhering to the tip. No. 2 is blistered on back and front. If the skin over the germ is blistered, it indicates that the germ has started to grow. The left hand kernel in pair No. 3 has light colored spots on the back, an indication of immaturity. The left hand kernel shows a well matured back of uniform color. Pair No. 4 shows broken tips, the tips having remained in the cob, exposing the germs, which would be more liable to decay in cold, wet ground. Pair No. 5 is badly blistered and off color on back and front. Pair No. 6 is cracked and decayed near the tips. Pair No. 7 has a light, dull color and is generally "chaffy." No. 8 is a pair of well matured, strong kernels.

Score Card for Corn Judging.

The following is the score card of the Indiana Corn Grower's Association, with brief explanations and rules for judging, as revised and adopted by the association at the annual meeting held January 4, 1905.

The purpose of the score card is to aid the judge or student in corn judging to arrive at a just conclusion as to the relative merits of samples of corn. The scale of points may be used in judging either single ears or exhibits made up of any number of ears.

Nothing but practice and the exercise of sound sense will enable one to use the score card correctly. The explanations of the points, given below, are merely suggestions of what should be looked for.

The rules for judging are based upon an exhibit of ten ears.

CORN SCORE CARD

OF THE

INDIANA CORN GROWER'S ASSOCIATION.

Name of Variety_____ Table No._____

Name of Scorer_____ Sample No._____

		1	2	3	4	5	6	7	8	9	10
1. Trueness to Type or Breed Characteristics	10										
2. Shape of Ears	5										
3. Color of Grain and Cob	10										
4. Vitality or Seed Condition	10										
5. Tips of Ears	5										
6. Butts of Ears	5										
7. Kernel Uniformity	10										
8. Kernel Shape	10										
9. Length of Ears	5										
10. Circumference of Ears	5										
11. Space between rows and kernels	10										
12. Proportion of Corn to Cob	15										
Total - -	100										

REMARKS AND REASONS FOR CUTS:

Explanation of Points of Corn Score Card.

Note A. Cuts—Where the number of points to be cut is not specified, the scorer must use his best judgment and cut each off ear according to its degree of variance from the standard and the value of the perfect ear.

Note B. Disqualifications—A white cob in yellow corn or a red cob in white corn should disqualify the exhibit. An ear whose vitality has been killed should also disqualify the exhibit.

Note C. Size of Exhibits—Each exhibit should consist of ten ears.

---

1 Trueness to Type or Breed Characteristics. 10 Points—All the ears in the exhibit should be true to the variety type in size, shape, color, indentation, size and shape of kernel, and other breed chacteristics.

2 Shape of Ears. 5 Points—The Shape of the ears should conform to the variety type. The ear should be full and strong in the middle portion and should not taper too rapidly towards the tip. The rows should be straight.

3 Color of Grain and Cob. 10 Points—The color of the grain should be true to variety, even in shade, and free from mixture. White corn should have white cobs and yellow corn, red cobs. For one or two mixed or crossed kernels on an ear cut one-fourth point, for three or four cut one-half point, for five or six cut three-fourths point and for more than six cut one point. Varying shades of color in grain or cob should be cut according to the degree of variance from the standard.

4 Vitality or Seed Condition. 10 Points—The ears should be well matured, firm and sound. The germ should be uninjured, large, bright, fresh and vigorous looking

5 Tips of Ears. 5 Points—The form of the tip should be regular and not too tapering. It should be well covered with straight rows of regular kernels, of uniform size and shape. Proportion of tip covered must be considered, but iregular, shallow or small kernels may be more objectionable than uncovered tips. Cut one-half point for each tip exposed one inch. For irregularities and lesser

exposures cut from one-tenth to one-half point according to judgment.

6 Butts of Ears. 5 Points—The rows of kernels should extend in regular order over the end of the cob, leaving a depression when the shank is removed Open, swelled, expanded, flattened and pinched butts are objectionable. Cut from one-tenth to one-half point according to judgment.

7 Kernel Uniformity. 10 Points—The kernels of all the ears in the exhibit should be uniform in size, shape, color and indentation and true to the variety type.

8 Kernel Shape. 10 Points—The kernels should be deep and so shaped that their edges touch from tip to crown. The tips of the kernels should be full and strong, giving room for large strong germs, which insures vigor as well as high feeding value. Very small or very large kernels are undesirable.

9. Length of Ears. 5 Points—The length of the ears should conform to the standard for the variety. Uniformity in length is desirable. Add together the deficiencies and excesses in length and for each inch so obtained, cut the exhibit one-half point.

10 Circumference of Ears. 5 Points—The circumference of each ear should conform to the standard for the variety, or should be in symmetery with the length. Measure the circumference at one-third the distance from butt to tip of ear and for each inch of the sum of the deficiencies and excesses, cut the exhibit one-half point.

11 Space Between Rows and Kernels. 10 Points—The furrows between the rows of kernels should be wide enough to permit the ear to dry out readily, but not so wide as to lose in proportion of corn to cob. Space between kernels at the cob, in either direction, is highly objectionable, denoting immaturity, lack of vitality, low feeding value and a small proportion of corn to cob. Space of this kind should be cut heavily.

12 Proportion of Corn to Cob. 15 Points—The proportion of corn to cob should be determined by weight and should conform to the standard for the variety. For each per cent below standard cut the exhibit one and one-half points.

General Standard of Perfection for Indiana.

A perfect ear of corn should be cylindrical, or nearly so, in shape. The length should be not less than eight inches and the circumference should be three-quarters of the length. The rows should be straight and not less than sixteen in number. The kernels should be well formed, uniform in size and shape, and not more than seven to the inch in the rows. The proportion of corn to cob should be not less than 86 per cent.

II. PROGRESS OF EXPERIMENTS IN CORN IMPROVEMENT.

A number of experiments have been begun on the Station farm and in various sections of the State with a view to ultimately improving the quality and yielding power of corn. Reports of the progress of some of these experiments will be found in the following pages.

Indiana already has a number of excellent varieties of corn and it is believed that these can be still further improved by closer attention to selective breeding. The use of the best existing varieties is still confined to a comparatively few farmers, and much profitable work may be done in their further dissemination. This is being attempted by local variety testing, and by breeding from individual ears of the varieties which give greatest promise in each locality. Local breeding plots are being established, where systematic work can be done.

Tests of Varieties of Corn.

In the spring of 1903 a series of corn variety tests were undertaken in various parts of the State in co-operation with students of the School of Agriculture The number of tests and the number of varieties tested were considerably increased in 1904, and many progressive farmers joined in the work. The Station furnishes the seed and gives directions as to methods of planting, general treatment, determination of yields, etc., while the farmers provide the land and necessary labor for the work.

The object of these variety tests is to determine the varieties best adapted to the various sections of the State and to bring them to the notice of the people. The wide variations in climatic and soil conditions between different sections of the State make it impossible to secure results at any one point which can be applied to localities at any considerable distance from it, so that the only way to make satisfactory tests is to conduct them in the localities where the results are to be applied. Testing the adaptations of existing

varieties is a necessary preliminary to the most effective work in improving corn for any locality.

On the whole these co-operative tests have been very satisfactory and by continuing them we shall be able, in the course of a few years, to determine pretty definitely which varieties are best suited to the various sections of the State.

The following is a list of the farmers who reported successful tests. Our thanks are due these men for the interest they have taken in the work and the labor and attention given to it.

R. E. Anderson, A. F. Batt, C. B. Benjamin, J. D. Bockstahler, Chapman Bros., J. G. Chambers, J. D. DeVore, E. F. Diehl, E. M. Elliott, W. H. Favinger, Charles Furnas, John Gardenour, A. B. Greenwood, G. C. Graverson, F. M. Gresso, E. E. Jones, H. H. James, Geo. V. Kell, C. F. Kerr, J. W. Kunkel, E. S. Lemmon, P. C. C. Lamberson, R. P. Lamb, A. B. Lantz, A. G. Mace, Walter Mertz, A. B. Osmon, A. J. Pielemeier, C. W. Power, Lee Shrader, J. F. Schroeder, F. G. Salisbury, Mell Swallow, A. W. Toms, A. E. Thompson, C. P. Volle, L. M. Vogler, O. B. Whisler, Jerome Zechiel, Omer Hougham.

Our thanks are also due the following, who have donated seed corn for experimental purposes:—

W. A. Alexander, L. B. Clore, E. F. Diehl, J. P. Davis, F. P. Hoopengardner, A. G. Mace, J. R. Overstreet, Fred Palin, Marley Riley, H. M. Stout, A. E. Thompson, L. M. Vogler, J. D. Whitesides.

The varieties tested were selected, so far as possible, with a view to their fitness for the various localities. The results so far indicate that a few of the varieties tested in each section have particularly desirable qualities. It is also apparent that for the northern sections of the State really desirable varieties are scarce, and that there is much room for improvement. For the central and southern sections several excellent varieties exist, and the greatest need is to more widely disseminate them.

The tables below are so arranged as to show the total and relative yields secured in each test. All yields are calculated to the basis of a 90 per cent stand. It will be observed that the State was divided into six sections, corresponding somewhat to differences

in soil and climate. It is now apparent that for future work the northern divisions will have to be redivided, on account of local differences.

VARIETIES TESTED.

VARIETY	ORIGIN OF SEED	RELATIVE SIZE	RELATIVE EARLINESS
Gibson Co. White	Southern Indiana	Large	Late
Scott Co. White	" "	"	"
Vogler's White Dent	South Central Indiana	"	"
Pride of Indiana	" " "	"	"
Johnson Co. White Dent	" " "	"	"
Gold Standard	" " "	"	"
Boone Co. White	Central "	"	Med. to Late
Silver Mine	Central Illinois	"	Medium
Leaming	" "	Med. to Large	"
Reid's Yellow Dent	" "	" " "	"
Riley's Favorite	Central Indiana	Medium	Med. to Early
Golden Eagle	Central Illinois	"	" " "
Davis' Favorite	Central Indiana	"	" " "
Smith's Yellow Dent	Northern "	"	Early
Diehl's "O. J."	" "	"	"
Funk's 90 Day	Central Illinois	"	"
Early Yellow Dent	Northern Indiana	Med. to Small	"
Golden Surprise	Central Ohio	Small	"
Yellow Clarage	" "	"	"
White Cap Yellow Dent	Northern "	"	"
Ohio Early Gold Mine	" "	"	"

RESULTS OF CORN VARIETY TESTS---1903-1904.

	NORTHWESTERN SECTION										NORTHEASTERN SECTION						
	County, Year of Test, Yield in bushels per acre.																
VARIETIES TESTED	Benton		Lake	Porter	Starke	Pulaski	White	Fulton	Marshall		Kosciusko	Wabash	Whitley	Wells	Allen	DeKalb	Steuben
	1903	1904	1904	1904	1904	1904	1904	1904	1903	1904	1903	1904	1904	1904	1904	1904	1904
Early Yellow Dent		42 0	*70.0	22 5	65.	47.	42.	36.	56.	48.		42.	48.	90.	47.5	50.5	42.6
Smith's Yellow Dent		54.0	*69.7	*31.	†	49.	40.	50.	58.	54.		48.	*50.6	84.	47.	*51.5	49.
Funk's 90 Day		46.0	*54.0	*30.5	†	46.		31.2		46		54.	*39.4	40.	46.5	*52.3	40.
Diehl's "O. J."	50 0	40.0	*64 8		68.	43 5	40.	38.1		50.	73.0				48.		
Golden Surprise			*48.0	15.75	†	49.5				48.			45.		51.	*45.2	39.5
Ohio Early Gold Mine			43.2	21.													39.
White Cap Yellow Dent			44.3		†	38.5											45.
Yellow Clarage			*66.9	11.2	45.	41.5				36.			*39.4		46.	*43.2	39.2
Riley's Favorite	*64.0	62.0	*52.0	*18	†	*53.5	40.	32.5	48.	48.	68.5	48.	*50.6	76.	49.	*50.5	38.
Davis' Favorite		52.0	*69.7	*17.5		48.9	42.	38.	52.	54.		46.2	*50.	80.	48.		
Golden Eagle	57.0	48.0		*17 5	†	51.	*24	31.4		45.6	66.6	36.	*50.6	86.	49	*50.5	
Silver Mine		*78.0					40.	43.			88.6		*45.	75.			
Reid's Yellow Dent		49.0					42.	40.6	54.	60.	87.4	42.		82.			
Leaming	*69.0	*56.0					*36.			*66				72.			
Boone Co. White	*72.0	*82.0					*40.		*60.		81.6			78.			
Johnson Co. White	*75 0								*60.		85.8						
Home Variety—Av.			* (y) 62.5	15.			(y) 38.	(y) 40 8	(w) 54.			45.0	47.3	79.		(w) 46 7	52.

*Not mature. †Reported not mature.

RESULTS OF CORN VARIETY TESTS---1903-1904.---(Continued.)

	WEST CENTRAL SECTION.									EAST CENTRAL SECTION.								
	County, Year of Test. Yield in Buchels per Acre																	
VARIETIES TESTED	Tippecanoe		Morgan		Clinton	Montgomery	Boone	Vermillion	Hendricks	Hamilton		Henry		Bartholomew		Howard	Fayette	Johnson
	1903	1904	1903	1904	1903	1904	1904	1904	1904	1903	1904	1903	1904	1903	1904	1904	1904	1904
Riley's Favorite	46.2	27.5	52.0	48	58.0	50		40		42.7	44.5	50 2	38.2			56 2	40 8	
Reid's Yellow Dent	54.7	55	52.0	48	50.0	53	57	42.1	35	44.7	44.5	50.9	43.2			54.4	44.5	57 6
Leaming	59.6	50	50.0	48		51	58	51	36		56.5	60.3	48			56.5	40.8	62.1
Davis' Favorite		42.5		48		50	54				54		38 2			61.2	48.3	
Gold Standard				50		47	56	50.8	33		41		33.6			53.8	44 5	52.3
Silver Mine		50	40.0	38	55.0	48	50	51.4	33	47.8	39.8		38 2	48.9	24.9	48.2	29.7	50.0
Boone Co. White		50	50.0	45		54	56	53	31.5	56.6	47.5	48.4	39.6	49.6	30.6	60.5	44.6	59 0
Johnson Co. White		45	50.0	45	60.0	66	51	57	30	48.3	54	53.9	33 6	54.0	31.2	62.2	48.3	59.0
Pride of Indiana		45	44.0	42			57		30	51.1	50.5	52.5	37 8	52·2	31.8		36.5	
Vogler's White Dent				45			57		31.5		38		38.2	54.8	33.5		48.3	58.0
Scott Co. White				48											32.2		44.6	
Golden Eagle	41.7		45.0		50.0	50	57	41				40.0				51.4		
Funk's 90 Day		50				45										60.8		
Early Yellow Dent		45														54.5		
Smith's Yellow Dent																57 2		
Diehl's "O. J."	47.1				50.0					39.9		39.0				61.7		
Gibson Co. White															22			
Home Variety—Av		50		48		45	62	53		48 3	48	45.7	48			55	48.3	

RESULTS OF CORN VARIETY TESTS---1903-1904.---(Continued.)

	SOUTHWESTERN SECTION.												SOUTHEASTERN SECTION.	
	County, Year of Test, Yield in bushels per acre.													
VARIETIES TESTED	Knox		Gibson		Daviess	Pike	Knox	Spencer			Scott		Washington	Ripley
	1903	1904	1903	1904	1903	1903	1904	1904	1904	1904	1903	1904	1903	1904
Gibson Co. White		62.	84.4				40.	30.4	40.	59.		20.4		40.
Scott Co. White		54.6		79.			57.4	28.	50.		74.1	30.		28.
Pride of Indiana	52.4	48.	82.	72.	56.4	48.5		46.9	50.	62.	79.2	21.9	38.4	38.
Vogler's White Dent		56.		90.6			53.6	42.5	45.	63.		24.5		45.
Johnson Co. White	69.6	61.3	58.	85.	69.	60.	56.5	36.	45.	61.	85.2	36.5	38.8	40.
Boone Co. White	58.7	53.3	77.2	85.3	67.3	42.	61.5	31.	50.	58.	76.9	23.5	44	35.
Leaming		50.6	73.6	73.	56.2			26.					27.4	35.
Gold Standard		53.3		80.			52.7	47.	48.					35.
Reid's Yellow Dent		48.	65.3	73.	63.5	40.7		22.5					25.7	
Silver Mine											73.3			
Golden Eagle					46.	42.2							23.4	
Riley's Favorite					57.5	48.4								
Home Variety—Av.	52.5 (w)	54.6 (y)			65.			31.8 (w)		60.			35.8 (w)	

Examination of the above tables shows that there are considerable variations between varieties as to yielding power, but the results of one or two years tests must be considered quite inconclusive and varieties should not be selected hastily. The tests will have to be repeated before definite conclusions can be drawn.

Both seasons were unusually cool. In view of this fact it may be considered that some of the earlier varieties which are marked immature would give better results in a normal season.

Breeding Corn for Larger Yields and Greater Uniformity.

A number of experiments have been commenced with a view to improving the yielding power of corn and producing more uniform types.

Three varieties having desirable characteristics were chosen for this work. A number of ears of almost perfect uniformity were selected from several bushels of good seed corn of each. These lots were planted in separate fields, an ear to a row. The better rows and the very poor ones were detasseled and seed for the next year's planting was selected from the detasseled rows which gave the largest yields of the best ears. The results secured from the most productive ears in the first year's work are shown in the table below. An equal amount of corn was planted in each row. The yields are given in terms of bushels per acre.

Experiment No.....	Yields Secured in Bushels per Acre.
1 Three Best Ears	Ear No. 4 yielded at the rate of 50.6 bu. per acre
	" " 6 " " " " " 46.7 " " "
	" " 8 " " " " " 42.7 " " "
2 Three Best Ears	" " 4 " " " " " 60.0 " " "
	" " 6 " " " " " 65 0 " " "
	" " 10 " " " " " 73.0 " " "
3 Four Best Ears	" " 11 " " " " " 72.0 " " "
	" " 14 " " " " " 84.0 " " "
	" " 16 " " " " " 86.0 " " "
	" " 19 " " " " " 71.0 " " "

The results secured in three other experiments, in which the ears were primarily selected for their protein content, are given in the next table.

Experiment No.	Ear No.	Yields Secured	Ear No.	Yields Secured
1	1	45 bu. per acre	6	74 bu. per acre
	2	63 " " "	7	86 " " "
	3	60 " " "	8	51 " " "
	4	90 " " "	9	49 " " "
	5	88 " " "	10	35 " " "
2	402	56.0 bu. per acre	411	63.2 bu. per acre
	403	70.1 " " "		
3	619	56.0 bu. per acre	611	69.5 bu. per acre
	610	53.6 " " "	615	76.9 " " "
	609	72.3 " " "	616	70.4 " " "
	607	71.7 " " "	603	66.9 " " "
	621	72.9 " " "	605	66.3 " " "
	622	51.8 " " "	601	61.0 " " "

The above results show very clearly the influence of individuality upon productiveness. By selecting seed from the product of the ears which gave the largest yields of good type we expect to very materially improve the prepotency and yielding power of these varieties. Similar methods of selective breeding, as described in part III of this bulletin, can be practiced by any farmer and will be found not only interesting but highly profitable.

FIG. 11.

Fig. 11 represents one of the breeding plats above referred to which contained two very poor rows, the one nearest the middle of the picture being particularly weak. The germination was weak and the growth very backward all through the season. The two next rows to the right are especially strong and vigorous.

EFFECT OF LIMITED NUTRITION UPON PERCENTAGE OF BARREN STALKS.

In the spring of 1903 an experiment was begun with a view ot studying the effect of limited nutrition upon the proportion of barren stalks in corn. In order to more thoroughly limit the amount of nourishment available for each stalk, a piece of ground that had been in corn continuously for twenty years, and was badly run down, was selected for the experiment. The field was divided into

18 plots of four rows each. The four rows of each plot were planted with 1, 2, 3 and 4 stalks per hill, respectively, giving 18 rows of each thickness of planting and insuring as great uniformity of conditions as possible. The yields, as shown in the table below, indicate that the amount of nourishment available for each stalk was small, even in the one-stalk rows.

The percentage of barren stalks in each thickness of planting was determined shortly before cutting the corn by counting the stalks which had not set an ear. The yields of ear corn and fodder were also determined, with the proportion of each.

The experiment was repeated in 1904, using the same plots but reversing the order of planting; that is, putting the 4-stalk rows where the 1-stalk rows were in 1903.

The table below shows the results for the two years.

Stalks per hill	Yield of ear corn per plat in bushels per acre				Per cent. of Good ears		Per cent. of ears to fodder		Per cent of barren stalks	
	1903		1904							
	Good Corn	Poor Corn	Good Corn	Poor Corn	1903	1904	1993	1904	1903	1904
1	14.77	1.14	12.51	1.0	92.8	92.0	52.2	49.5	0.44	6.5
2	21.23	1.87	16.16	3.24	91.9	83.3	48.3	49 4	1.41	12.3
3	18.12	3.69	9.57	6.41	83.1	60.8	44.2	36.0	9.22	34.5
4	16.76	6 23	9.30	8.38	72.9	52.6	41 5	33.4	9.89	40.74

An examination of the above table will show that the percentage of barren stalks was very materially increased as the proportion of nourishment available for each stalk was lessened, especially in 1904. The difference between the two years' results may be accounted for by the fact that in the latter year the soil was very dry during the time the ears were forming, so that the amount of nourishment received by each stalk must have been still further limited than in 1903, when there was a fair amount of moisture.

The table also shows that the proportions of good to poor corn and of corn to fodder were materially lessened by the thicker plant-

ing, though the amount of fodder increased with the thickness of planting.

It must be remembered, however, that the soil upon which these experiments were conducted was very poor and that on rich soil the differences would not be nearly so great. We should remember also, in summing up the results, that the total yields of corn must be considered.

Figures 12, 13 and 14 show the total yields and proportions of good and poor corn from each thickness of planting.

Breeding Corn for Higher Feeding Value.

In the spring of 1903 experiments in the improvement of the feeding value of corn were begun in co-operation with six growers in different sections of the state, using five varieties, namely: Johnson County White Dent, Pride of Indiana, Orth's Hominy, Early Yellow Dent, and Silver King. Lots of ears selected for their physical appearance were in each case sent to the Station for analysis in order to select for seed the ears showing the highest per cent of protein.

The selected ears were in each case planted in separate rows, side by side. In about half of the cases each year it was found necessary to put the breeding plot on one side of a large corn field of the same variety, as suitable isolated places could not be secured. The plots were, however, always placed to the south or west of the main field, which gave them some protection, since the prevailing winds at the time of fertilization usually come from a southerly or westerly direction. The better ears were usually planted towards the middle of the plot, protecting them still further from undesirable pollen.

Shortly before tasseling time all rows were carefully examined and the better ones, judged by their thriftiness and the composition of the seed, were selected for detasseling. The detasseled rows being intended to furnish the seed ears for the next year. The rows for detasseling were usually selected so as to alternate with tassel rows, but occassionally it was found desirable to detassel two rows side by side. The tassel rows furnished plenty of pollen. Besides

FIG. 12—Plot 2, two-stalk rows, good and poor corn. Plot 1, one-stalk rows, good and poor corn.

FIG. 13 Plot 2, two-stalk rows, good and poor corn. Plot 3, three-stalk rows, good and poor corn.

FIG. 14—Plot 2, two-stalk rows, good and poor corn. Plot 4, four-stalk rows, good and poor corn,

the rows from which seed was to be selected, all weak or otherwise undesirable stalks were also detasseled, so that their pollen would not take part in fertilizing the detasseled rows.

When the corn was ripe, ears for the next year's planting were selected from the detasseled rows which gave the largest yields of desirable ears, first by a mechanical examination of the kernels for high protein and fat content, as described in part III of this bulletin, and then by chemical analysis.

The chemical analyses were made by the Chemical Department of the Station, to which credit for the same should be given.

The table below shows the average composition of the corn from which the first year's seed was selected, the average composition of the seed ears used for planting each year, and the composition of the best single ear, in each case. It will be observed that considerable gains in the protein content of the seed were made during the first year and that during last year there was a falling off in the average composition in all cases except one. No satisfactory explanation of this can be found at present. The work will need to be continued some time longer before conclusions as to its practical application can be drawn.

Table Showing Progress of Work in Breeding Corn for Higher Feeding Value---1903-1905.

Experiment No. and Name of Variety	Average Composition of Corn From Which First Seed Was Selected	Average Composition of Seed Ears Used 1903	Best Single Ear 1903	Average Composition of Seed Ears Used 1904		Best Single Ear 1904		Average Composition of Seed Ears for Use 1905		Best Single Ear for 1905	
	Protein %	Protein %	Protein %	Protein %	Fat %	Protein %	Fat %	Protein %	Fat %	Protein %	Fat %
1 Johnson Co. White Dent	10.58	11.76	12.25	12.23	4.53	13.44	4.36	11.84	4.52	12.41	4.30
2 Johnson Co. White Dent	10.82	11.33	11.91	12.06	5.01	12.87	6.07	11.39	4.99	12.79	4.96
3 Pride of Indiana	10.49	11.58	12.06	12.07	4.63	13.12	4.64	11.99	4.28	12.73	5.14
4 Orth's Hominy	11.37	11.89	12.69	12.92	4.93	14.81	5.23	11.73	4.91	12.44	4.57
5 Early Yellow Dent	10.52	12.06	12.13	12.70	5.02	13.18	5.12	12.26	4.59	13.13	5.30
6 Silver King	10.42	11.55	12.44	11.27	4.41	13.25	5.05	11.84	4.55	12.75	4.32

III. CORN BREEDING FOR PRACTICAL FARMERS.

The improvement of corn by breeding along definite lines is no longer a work for the scientist or professional seed-corn grower alone. That it can be done easily, and by every farmer on his own farm, has been proven beyond a doubt. Simple and effective methods have been worked out and thoroughly tried. These any farmer can follow, and, by the use of a little judgment in selecting his seed, he can, in a short time, make very marked progress towards producing what he wants. The greatest success will, of course, come to those who have a taste for the work and who are prepared to give it the necessary care and attention. If properly attended to, the time given to the work will be many times repaid by the larger and better crops produced. Selecting seed from the products of individual ears is the only rapid way of improving corn along any line. A study of the yields from individual ears recorded in part II of this bulletin will show what may be expected.

Breeding for Large Yields and Uniform Quality.

To begin with, select the breed of corn which has the most desirable characteristics and is suited to the locality. If a good type is not at hand, it will be wise to purchase a few bushels of good ears rather than to spend valuable time in breeding up a poor variety. It is like laying a foundation for a good herd of animals; the best obtainable should be secured as foundation stock.

Having in mind a clear idea of the type desired, select a number of good ears of fair size and as uniform as possible. A study of the illustrations in part I of this bulletin will be found useful in making this selection.

All the ears selected should be as nearly alike in every respect as possible.

The larger the number of ears used in this work of breeding the more rapid and pronounced will be the progress.

For the purpose of our illustration let us assume that twenty ears are selected. After a satisfactory selection has been made each ear should be tested and proven perfect in germinating power. The

ears should then be carefully tipped and butted, discarding all irregular, small or otherwise imperfect kernels. They may then be shelled and preserved separately until planting time, or they may be shelled directly into the planter at the time of planting.

For the breeding plot, select a uniform piece of ground in good average condition. This may be located in a place by itself, away from all other corn fields, or it may be one side of a regular corn field. If the latter location is chosen, it should be on the windward side of the field, i. e., on the side from which the prevailing winds come at the time of tasseling. This should be done in order that the rows may be protected as much as possible from the pollen of the corn in the main part of the field. Owing to the fact that corn is wind pollinated it is difficult to prevent cross-fertilization from other corn and can seldom be altogether avoided. Pollen will blow half a mile on a windy day. In locating the breeding plot the position of neighbor's corn fields must, therefore, also be considered. The danger of mixing can often be avoided by a week or ten days earlier or later planting.

The corn from each ear must be planted in a separate row, or in two or more rows, according to the length. Where more than one row per ear is required, the rows should alternate with rows planted from another ear. Two or more rows for each ear are usually preferable, because fertilization is likely to be more perfect. A careful record of the number of the row, or rows, inwhich each ear is planted should be made. For greater accuracy, and as a guide for future selection, it is wise to preserve a brief written description and pedigree of each ear used.

As soon as tassels begin to appear the largest number of desirable, but *alternate* rows should be selected for detasseling. If there appears to be much difference in the time of tasseling, select the earlier rows for detasseling. The outside row, or preferably the two outside rows, should not be detasseled. Assuming that the odd numbered rows are selected for detasseling, begin with row number 3 and carefully pull or cut out the tassels as rapidly as they appear. In no case should any of these be allowed to ripen pollen. Aside from these selected rows, all weak, or otherwise inferior stalks in the tassel rows should also be detasseled, so that they may not take

part in fertilizing the selected rows. The object of this detasseling is to prevent inbreeding. Experiments have shown that inbreeding weakens the constitution of the corn and lessens future yields.

When the corn is ripe, husk the product of each of the detasseled rows separately. In case there was more than one of these planted from a single ear, they should be put together. You can now compare the products of the various ears and make your selection of single ears for the next year's planting. In determining the lots from which to select, the two important factors to be taken into consideration are the yield and the proportion of ears of the desired type. Select from the rows, or lots, which gave the largest yields and the largest proportion of ears true to the desired type. Both factors must be considered. Accurate weights of the yields must be made, and these should be recorded in the pedigrees of the ears which produced them. Selection should be made only from the detasseled rows, because they are the only rows of which you are sure that they have not been inbred. Select from at least two lots and use the ears from the better one for the mother plants, or the detasseled rows, next year. If four or six rows are good enough to select from they should be used in order to prevent possible harm from too close breeding. After you have made your selection for next year's seed-plot, the remainder of the good ears in the good lots should be selected as seed for the next year's bulk crop. A continuation of this method of breeding and selection is bound to result in more and better corn from year to year.

The beginner in corn breeding need not be deterred by the labor invalued. It will be found to be the best paying work on the farm. Even though all the details of the system outlined above cannot be carried out, every farmer who produces his own seed corn should use this individual ear and row method.

Breeding for Higher Feeding Value.

In breeding for higher feeding value the same general methods as in breeding for yield and uniformity are followed, with the addition of selecting the ears that are rich in the important food constituents, namely, protein and oil.

In selecting ears for this purpose due attention must be given,

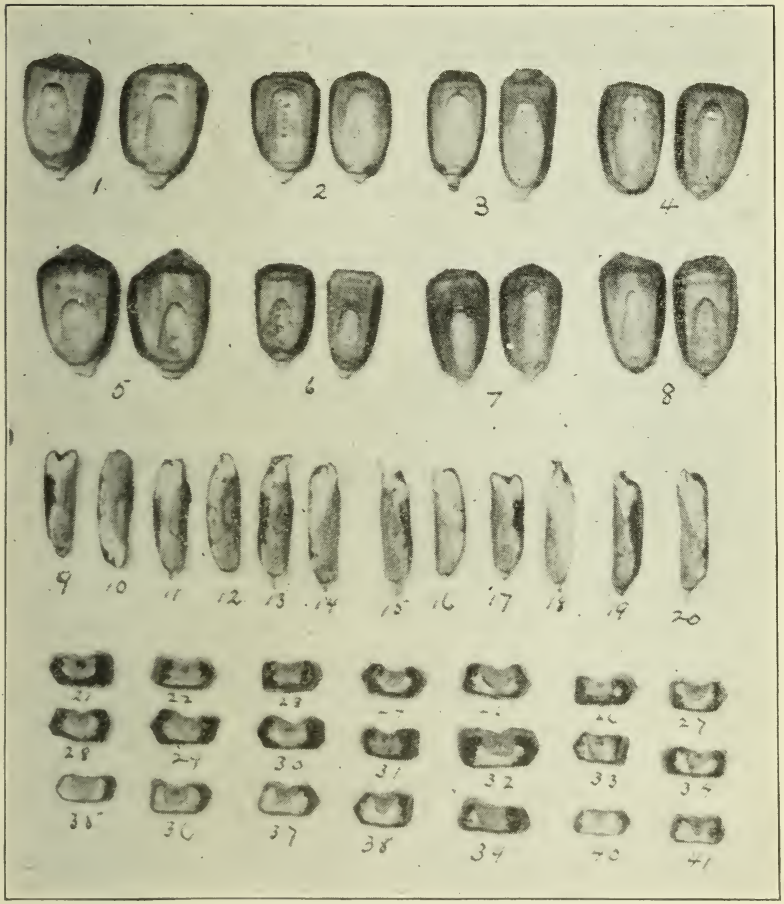

FIG. 15.

SHOWING DIFFERENCES IN PROPORTIONS OF GERM, HARD, HORNY MATTER AND WHITE, FLOURY MATTER IN KERNELS FROM DIFFERENT EARS OF CORN.

first of all, to yielding power and uniformity. These qualities must never be lost sight of. Otherwise, while improving the feeding value per pound of corn, the variety may be injured in other respects.

The feeding value of a grain of corn depends upon the amount of protein (flesh producing material) and fat it contains. The germ is rich in protein and contains nearly all the oil in the kernel. The hard, horny matter contains most of the protein, while the white, floury portion contains relatively little of either protein or fat. Bearing this in mind, the relative feeding value of two ears of corn can be roughly determined by an examination of the kernels. The larger the germ and the greater the proportion of hard, horny matter to white, floury matter the higher the feeding value. It has been found that the ears of any variety vary considerably in composition but that the kernels on each ear are of approximately the same composition. It is therefore comparatively easy to select the eras of highest feeding value.

Fig. 15(p. 324)shows, in the upper row, kernels from ears of high feeding value. Observe the large germs. The second row shows kernels from ears of the same varieties which are low in feeding value. The longitudinal and cross sections of kernels show very clearly how widely the proportions of germ, hard horny and white floury portions may vary.

The larger the number of ears from which selection can be made the better. Select for their general qualities several times the number of ears you intend to use and then go over them carefully for their feeding value. Examine several kernels from each ear by cutting them crosswise through the middle, as shown in Fig. 15. The relative proportions of germ, horny and floury portions can thus be easily seen. By selecting the richer ears for seed, year after year, the feeding value of corn can be considerably increased.

Purdue University

Agricultural Experiment Station

BULLETIN No. 106, Vol. XII.

MAY, 1905

Commercial Fertilizers

PUBLISHED BY THE STATION,
LAFAYETTE, IND.,
U. S. A.

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COMMERCIAL FERTILIZERS.

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W. J. JONES, Jr., Chief Deputy.

Notice to Dealers and Consumers.

Do not buy, sell, offer for sale by sample or otherwise, or have in your possession, any fertilizer or sample of same unless it has attached to it the label of the State Chemist showing the number at the top higher than No. 2714.

Potash salts, nitrate of soda, tankage, dried blood and other raw material must bear a label the same as any other fertilizer.

Many persons think that the manufacturer of the fertilizer is the only one subject to penalties for violations of the law. This is not the case. Penalties may be inflicted on any one who has any fertilizer in his possession which is not labeled as required by law or which is not up to the standard shown on the label. If the dealer or purchaser wishes to shift the responsibility back to the original manufacturer it must be accomplished by a special clause in a written contract and may take the form of an agreement that the party may deduct from the obligation for the payment of the goods all costs and penalties or other loss incurred because of the goods not complying with the requirements of the Indiana Fertilizer Law. We are informed that some companies whose goods have always made an excellent showing on inspection have voluntarily made such contracts with their agents.

It sometimes happens that dealers who do not own or control a factory, register brands. There are some large firms that have for years employed factories to make their goods and these firms are to all intents and purposes manufacturers and sell these goods over a wide range of territory. There are other cases where a dealer has goods registered in his own name and sells only a limited amount For the first season the purchaser has only the reputation of the local dealer to recommend such goods, and it sometimes happens that an unscrupulous manufacturer does not fulfill his contract with the dealer. Until these purely local brands have been on the market long enough to admit of inspection and publication of the results it would be well for the purchaser to find out who made the goods and then look up the inspections of other goods made by the same manufacturer.

The working regulations of the office so far as they relate to manufacturers who wish to register goods and obtain labels will be furnished on application.

By direction of the Board of Trustees of the University, the work of administering the fertilizer law including the inspection and analyses of fertilizers and publication of results, was included in the functions of the Experiment Station on and after July 1, 1904. The above change will have no effect on the administration of the business so far as the fertilizer trade is concerned, and all rules and regulations heretofore in force will still apply.

THE INDIANA FERTILIZER LAW.

The full text of the law in regard to the sale of fertilizers in Indiana is as follows:

Section 1. Certificate to be Filed with State Chemist.

Before any commercial fertilizer is sold or offered for sale in the State of Indiana, the manufacturer, dealer, importer, agent, or party who causes it to be sold or offered for sale, by sample or otherwise, within the State of Indiana shall file with the State Chemist of Indiana a statement that he desires to offer for sale in Indiana material for manurial purposes, and also a certificate, for registration, stating the name of the manufacturer, the location of the principal office of the manufacturer, the name under which the fertilizer will be sold, the name of the towns in Indiana in which it will be offered for sale, and the minimum percentage of nitrogen, of potassium oxide (K2 O) soluble in water, of phosphoric acid (P2 O5), and in case of acidulated goods the minimum percentage of water soluble and reverted phosphoric acid, and of insoluble phosphoric acid, which the manufacturer or party offering the fertilizer for sale guarantees the fertilizer to contain.

Section 2. Registration of Certificate—Label.

It shall be the duty of the State Chemist to register the certificate provided for in section one (1) of this act, and to print the facts set forth in the certificate in the form of a label. Such label shall be plainly printed in the English language and shall set forth the name of the manufacturer, the location of the principal office of the manufacturer, the name of the fertilizer, and the minimum percentage of nitrogen, of potassium oxide (K2 O) soluble in water, of phosphoric acid (P2 O5) or in case of acidulated goods, of soluble and reverted phosphoric acid, and of insoluble phosphoric acid, which the manufacturer guarantees the fertilizer to contain. The State Chemist shall furnish such labels to manufacturers, or agents, desiring to sell, or to offer or expose to sale, the fertilizers so registered and in such numbers as such manufacturers or agents may desire: Provided, That the State Chemist shall not be required to furnish a less number than five hundred for any one fertilizer and shall only be required to furnish them in multiples of five hundred, and all labels shall be good until used.

Section 3. Labels to be Affixed to Samples, Packages and Delivered with Goods Sold in Bulk.

Any person, company, corporation or agent that shall manufacture, offer for sale, sell or expose for sale by sample or otherwise, or have in his possession for his own use or for the use of another, any commercial fertilizer, shall affix or cause to be affixed to every package or sample of such fertilizer, in a conspicuous place on the outside thereof, the label of the State Chemist provided for in section two (2) of this act. When fertilizers are sold in bulk a label shall be delivered to the purchaser with each two hundred pounds or fraction thereof.

Section 4. Penalties.

Any person, company, corporation or agent, that shall offer for sale, sell or expose for sale, by sample or otherwise, or have in his possession for his own use or for the use of another, any package or sample or any quantity of any commercial fertilizer which does not have affixed to it the label of the State Chemist, or which shall be found by an analysis made by or under the direction of the State Chemist, to contain a smaller percentage of any one of the ingredients mentioned in section two of this act, than the label of the State Chemist shows

it is guaranteed to contain, or which shall be labeled with a false or inaccurate guarantee, or any person, company, corporation or agent, that shall use the name or title of the State Chemist on a label not furnished by the State Chemist, shall be deemed guilty of a misdemeanor, and on conviction thereof, shall be fined in the sum of $50 for the first offense and in the sum of $100 for each subsequent offense. In all litigation arising from the purchase or sale of any commercial fertilizer in which the composition of the same may be involved, a certified copy of the official analysis signed by the State Chemist shall be accepted as conclusive proof of the composition of such fertilizer: Provided, That nothing in this act shall be so construed as to prevent a farmer mixing fertilizer materials sold under provisions of this act, for his own use, or to prevent manufacturers, who have complied with the provisions of section one, two and three of this act, having in stock raw material for the manufacture of fertilizers, or to prevent the State Chemist, or the United States Agricultural Experiment Station for Indiana, or any person or persons deputized by said State Chemist, making experiments with agricultural chemicals for the advancement of the science of agriculture.

Section 5. State Chemist—Fees—Inspection.

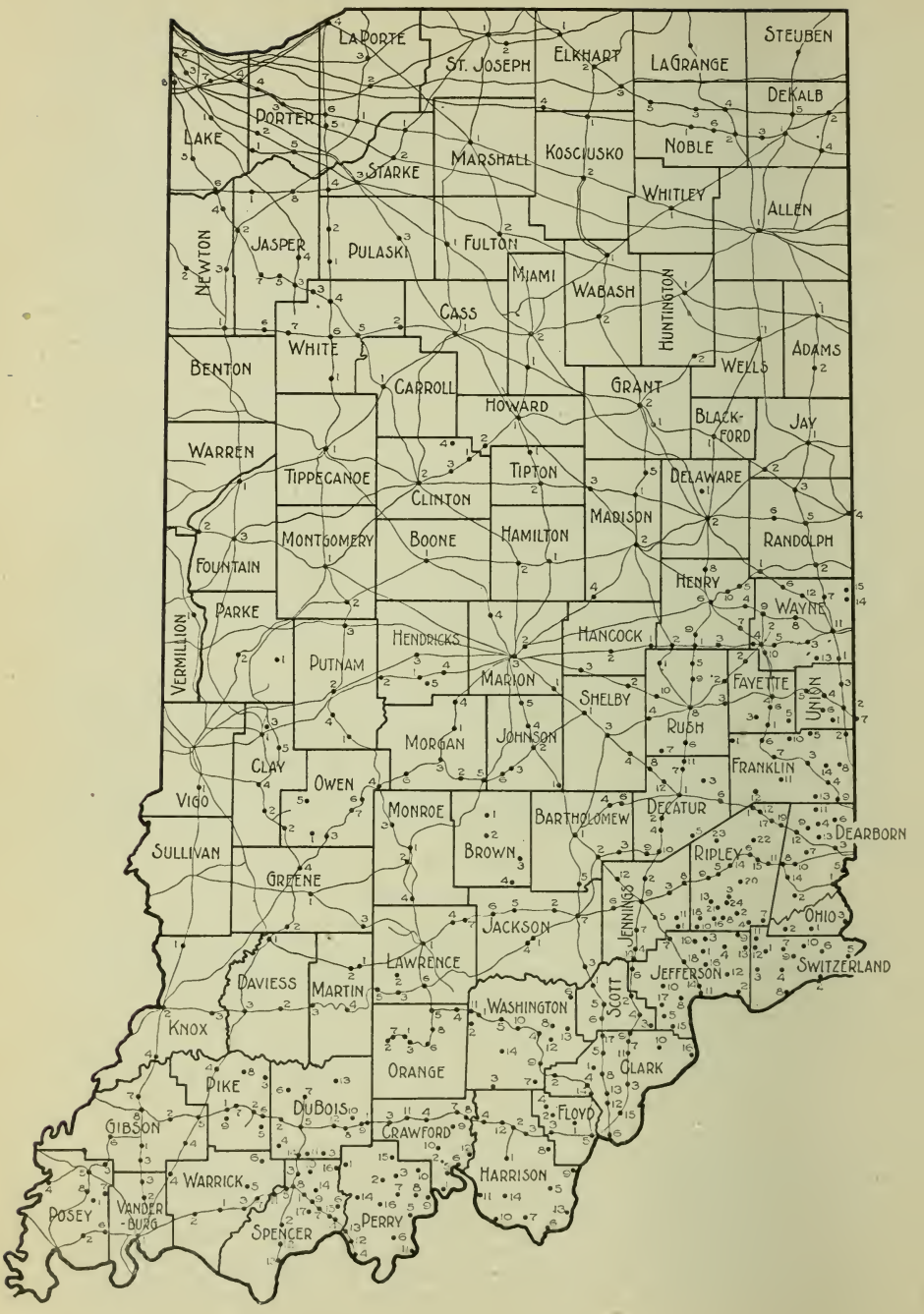
The Professor of Agricultural Chemistry at Purdue University is hereby constituted the State Chemist of Indiana, and it shall be his duty to comply with the provisions of this act so far as they relate to him, and for his expenses and compensation in inspecting and analyzing fertilizers, he shall receive for analyzing a sample of fertilizer and making his certificate of the same, $2, for labels furnished, one dollar per hundred. The State Chemist or any person by him deputized is hereby empowered to procure from any package of commercial fertilizer offered for sale or found in Indiana a quantity of fertilizer not exceeding two pounds: Provided, Such sample shall be drawn during reasonable business hours, or in the presence of the owner of the fertilizer, or of some party claiming to be the representative of the owners.

Any person who shall prevent or strive to prevent the State Chemist, or any person deputized by the State Chemist, from inspecting and obtaining samples of fertilizers, as provided for in this act shall be deemed guilty of misdemeanor, and upon conviction thereof, shall be fined not less than fifty dollars for the first offense, and not less than one hundred dollars for each subsequent offense. The State Chemist is hereby empowered to prescribe and enforce such rules and regulations relating to fertilizers as he may deem necessary to carry into effect the full intent and meaning of this act.

Section 6. The Term "Commercial Fertilizer" Defined.

The term "commercial fertilizer" as used in this Act shall be taken to mean any and every substance imported, manufactured, prepared, or sold for fertilizing or manurial purposes, except barn-yard manure, marl, lime, wood-ashes and plaster.

Fertilizer Map—See Next Page.



FERTILIZER MAP.

The map reproduced on the preceding page was prepared in order to give some idea of the amount of fertilizer sold in different sections of the State. The estimated annual sales in all the important distributing points will be found in the tabulated statement following. Owing to the fact that the Indiana Ferilizer law does not require dealers to report sales, it is difficult to obtain reliable data in regard to the amounts sold. The estimates given are based on information obtained by our deputies on their inspection trips.

The towns are numbered on the map in each county to correspond with the numbers in the second column of the table following.

It will be seen by referring to the map that by far the largest portion of the fertilizer sold is used in the southern part of the state. This is largely because the clay soils of that section are as a rule more deficient in plant food than the black soils of the northern portion. It has been observed in the State Chemist's office, however, that the trade is gradually extending northward and it will undoubtedly only be a question of a comparatively short time until large quantities of fertilizer are used in the northern portion of the state.

LIST OF TOWNS.

County	No. Town on Map	Name of Town	Estimated Sales per Year in Tons
Adams	1	Decatur	....
	2	Berne	....
Allen	1	Fort Wayne	38
Barthdolomew	1	Columbus	100
	2	Elizabethtown	150
	3	Grammar	50
	4	Hope	100
	5	Jonesville	50
	6	Rugby	50
Benton	..		....
Blackford	1	Hartford City	....
Boone	1	Lebanon	20
Brown	1	Bean Blossom	75
	2	Nashville	50
	3	New Bellsville	50
	4	Lockman	50
Carroll	1	Delphi	2
Cass	1	Logansport	25
Clark	1	Blue Lick	....
	2	Borden	100
	3	Charlestown	100
	4	Dallas	....
	5	Henryville	75
	6	Jeffersonville	50
	7	Marysville	50
	8	Memphis	50
	9	Nabb	75
	10	New Wash'ton	50
	11	Otisco	75
	12	Sellersburg	50
	13	Speeds	25
Clark	14	St. Joseph Hill	30
	15	Watson	25
	16	Bethlenem	....
	17	Underwood	40
Clay	1	Brazil	....
	2	Clay City	20
	3	Jackson	....
	4	Saline City	....
	5	Asherville	....
Clinton	1	Forest	....
	2	Frankfort	....
	3	Michigantown	....
	4	Middle Fork	....
Crawford	1	Alton	50
	2	Beechwood	25
	3	Eckerty	100
	4	English	75
	5	Fredonia	25
	6	Leavenworth	50
	7	Marengo	75
	8	Milltown	75
	9	Pilot Knob	50
	10	Riddle	40
	11	Taswell	50
	12	Wyandotte	25
Davies	1	Elnora	25
	2	Montgomery	40
	3	Washington	20
Dearborn	1	Aurora	10
	2	Dillsboro	200
	3	Guilford	50
	4	Kelso	50
	5	Lawrenceb'rg	....
	6	Logan	50
	7	Manchester	100
Dearborn	8	Moores Hill	100
	9	New Alsace	30
	10	Sparta	40
	11	St. Leon	50
	12	Weisburg	50
	13	Yorkville	25
	14	Coldsprings	....
Decatur	1	Greensburg	400
	2	Horace	40
	3	Kingstown	25
	4	Letts	50
	5	Millhausen	200
	6	New Point	75
	7	Sandusky	75
	8	St. Paul	150
	9	Sardinia	50
	10	Westport	70
	11	Williamstown	75
	12	Adams	50
Dekalb	1	Auburn	100
	2	Butler	50
	3	Garrett	....
	4	St. Joe Station	50
	5	Waterloo	...
Delaware	1	Anthony	....
	2	Muncie	25
Dubois	1	Bird's Eye	75
	2	Duff	40
	3	Ferdinand	200
	4	Holland	100
	5	Huntingb'rg	100
	6	Ireland	50
	7	Jasper	200
	8	Kyana	75
	9	Mentor	50
	10	Schnellville	100

LIST OF TOWNS—Continued.

County	No. Town on Map	Name of Town	Estimated Sales per Year in Tons
Dubois	11	St. Henry	75
	12	St. Anthony	75
	13	Dubois	50
	14	Johnsburg	50
Elkhart	1	Elkhart	40
	2	Goshen	40
	3	Millersburg	20
	4	Nappanee	120
Fayette	1	Alpine	40
	2	Bentonville	40
	3	Columbia	50
	4	Connersville	200
	5	Everton	200
	6	Nulltown	100
Floyd	1	Floyd Knobs	100
	2	Galena	100
	3	Georgetown	200
	4	Greenville	100
	5	New Albany	400
Fountain	1	Attica	10
	2	Covington	10
	3	Veedersburg	....
Franklin	1	Andersonville	100
	2	Bath	100
	3	Brookville	200
	4	Cedar Grove	50
	5	Fairfield	75
	6	Laurel	50
	7	Metamora	40
	8	Mt. Carmel	100
	9	New Trenton	50
	10	Blooming Grove	75
	11	Oakforest	100
	12	Oldensburg	100
	13	South Gate	100
	14	Wynn	75
Fulton	1	Kewanna	60
	2	Rochester	10
Gibson	1	Fort Branch	40
	2	Francisco	40
	3	Haubstadt	100
	4	Mackey	25
	5	Oakland City	50
	6	Owensville	20
	7	Patoka	40
	8	Princeton	40
Grant	1	Gas City	....
	2	Marion	25
Greene	1	Bloomfield	40
	2	Newberry	40
	3	Owensburg	100
	4	Worthington	40
Hamilton	1	Noblesville	75
	2	Westfield	....
Hancock	1	Charlottesville	50
	2	Greenfield	10
	3	New Palestine	25
Harrison	1	Corydon	1000
	2	Corydon Jct.	200
	3	Crandall	100
Harrison	4	Depauw	100
	5	Elizabeth	200
	6	Evans Landi'g	100
	7	Laconia	200
	8	Lanesville	200
	9	Locust Point	50
	10	Mauckport	100
	11	New Ams'dam	100
	12	Ramsey	100
	13	Rosewood	100
	14	Central	100
Hendricks	1	Clayton	....
	2	Coatsville	....
	3	Danville	25
	4	Plainfield	....
	5	Belleville	....
Henry	1	Dunreith	50
	2	Knightstown	100
	3	Lewisville	50
	4	Milville	25
	5	Moreland	....
	6	New Castle	....
	7	New Lisbon	50
	8	Springport	....
	9	Spiceland	....
	10	Messick	....
Howard	1	Kokomo	....
	2	Russiaville	....
Huntington	1	Huntington	25
	2	Warren	....
Jackson	1	Brownstown	100
	2	Cortland	100
	3	Crothersville	100
	4	Ewing	50
	5	Freetown	100
	6	Kurtz	100
	7	Seymour	100
Jasper	1	De Motte	25
	2	Fair Oaks	25
	3	McCoysburg	35
	4	Pleasant Grove	25
	5	Pleasant Ridge	50
	6	Remington	40
	7	Rensselaer	80
	8	Wheatfield	25
Jay	1	Portland	....
	2	Red Key	....
Jefferson	1	Belleview	100
	2	Brooksburg	25
	3	Bryantsburg	50
	4	Canaan	100
	5	Chelsea	50
	6	Deputy	150
	7	Dupont	100
	8	Hanover	100
	9	Hicks	....
	10	Kent	100
	11	Madison	200
	12	Manville	30
	13	McGregor	50
	14	No Madison	200
	15	Saluda	40
	16	Stony Point	....
	17	Swanville	....
Jefferson	18	Wirt	100
	19	Big Creek	40
Jennings	1	Bigger	50
	2	Brewersville	50
	3	Butlerville	100
	4	Commiskey	100
	5	Grayford	50
	6	Haydea	100
	7	Lovett	100
	8	Nebraska	100
	9	No. Vernon	200
	10	Paris Crossing	200
	11	San Jacinto	50
	12	Scipio	25
Johnson	1	Edinburg	50
	2	Franklin	100
	3	Trafalgar	200
	4	Whiteland	50
	5	Greenwood	50
	6	Samaria	75
Knox	1	Oaktown	25
	2	Vincennes	100
	3	Wheatland	....
	4	Decker	....
Kosciusko	1	Milford	40
	2	Warsaw	....
Lagrange	1	Lagrange	....
Lake	1	Crown Point	25
	2	Hammond	....
	3	Highlands	50
	4	Hobart	20
	5	Lowell	....
	6	Shelby	....
	7	Ross	....
	8	Saxon	....
Laporte	1	Hanna	....
	2	Kingsbury	25
	3	Laporte	25
	4	Michigan City	....
	5	So. Wanatah	....
	6	Wanatah	20
Lawrence	1	Bedford	100
	2	Bryantsville	....
	3	Georgia	....
	4	Heltonville	200
	5	Huron	....
	6	Mitchell	100
	7	Zelma	50
Madison	1	Alexandria	....
	2	Anderson	25
	3	Elwood	....
	4	Ingalls	....
	5	Summitville	....
Marion	1	Acton	50
	2	Brightwood	....
	3	Indianapolis	200
	4	Augusta	25
Marshall	1	Plymouth	....
Martin	1	Cale	25
	2	Indian Springs	50

LIST OF TOWNS—Continued.

County	No. Town on Map	Name of Town	Estimated Sales per Year in Tons
Martin	3	Loogootee	2 100
	4	Shoals	50
Miami	1	Bunkerhill	40
	2	Peru	10
Monroe	1	Bloomington	15 500
	2	Clear Creek	....
	3	Elletsville	200
	4	Harrodsburg	100
Montgomery	1	Crawfordsville	....
	2	Ladoga	....
Morgan	1	Brooklyn	20
	2	Mahalasville	....
	3	Martinsville	100
	4	Mooresville	40
	5	Morgantown	17 100
	6	Paragon	....
Newton	1	Goodland	40
	2	Morocco	50
	3	Mt. Ayr	25
	4	Rose Lawn	50
Noble	1	Albion	20
	2	Avilla	....
	3	Brimfield	....
	4	Kendalville	160
	5	Ligonier	20
	6	Ripley	....
Ohio	1	Bascom	50
	2	Bear Branch	100
	3	Rising Sun	18 ....
Orange	1	Abydel	25
	2	French Lick	14 50
	3	Glass Rock	25
	4	Leipsic	200
	5	Orleans	10 100
	6	Paoli	17 100
	7	West Baden	50
	8	Lost River	200
Owen	1	Arney	....
	2	Coal City	....
	3	Freedom	25
	4	Gosport	100
	5	Patricksburg	100
	6	Romona	....
	7	Spencer	2 100
Parke	1	Hollandsburg	....
	2	Rockville	....
Perry	1	Adyeville	50
	2	Apalona	100
	3	Branchville	50
	4	Cannelton	17 50
	5	Derby	25
	6	German	....
	7	Leopold	200
	8	Magnet	16 50
	9	Mt. Pleasant	100
	10	Oriole	100
	11	Rome	10
	12	Tell City	16 100
	13	Troy	16 100
	14	Prospero	100
	15	St. Croix	100
Perry	16	Terry	100
Pike	1	Ayrshire	....
	2	Hartwell Junc.	....
	3	Otwell	25
	4	Petersburg	50
	5	Pikeville	....
	6	Velpen	100
	7	Winslow	100
	8	Algiers	....
	9	Arthur	....
Porter	1	Hebron	....
	2	Hurlburt	50
	3	Valparaiso	100
	4	Wheeler	....
	5	Kouts	25
Posey	1	Blairsville	....
	2	Caborns	50
	3	Cynthiana	10
	4	New Harmony	....
	5	Poseyville	....
	6	St. Philip	100
	7	St. Wendels	75
	8	Wadesville	10
Pulaski	1	Francesville	250
	2	Medaryville	50
	3	Winamac	100
Putnam	1	Cloverdale	40
	2	Greencastle	25
	3	Roachdale	....
	4	Putnamville	....
Randolph	1	Losantville	....
	2	Lynn	....
	3	Ridgeville	....
	4	Union City	25
	5	Winchester	....
	6	Farmland	....
Ripley	1	Batesville	16 200
	2	Benham	100
	3	Correct	100
	4	Cross Plains	100
	5	Dabney	50
	6	Delaware	50
	7	Friendship	50
	8	Hayneys Cor	50
	9	Holten	2 100
	10	Marble Corner	25
	11	Milan	2 100
	12	Morris	100
	13	New Marion	100
	14	Osgood	16 200
	15	Pierceville	100
	16	Rexville	50
	17	Spades	50
	18	St. Magdalene	50
	19	Sunman	10 150
	20	Versailles	200
	21	Gaff	50
	22	Lookout	....
	23	Napoleon	200
	24	Titusville	50
Rush	1	Carthage	50
	2	Falmouth	25
	3	Glenwood	100
	4	Manilla	50
Rush	5	Mays	25
	6	Milroy	17 200
	7	Moscow	25
	8	Rushville	4 300
	9	Sexton	25
	10	Arlington	....
St. Joseph	1	Mishawaka	....
	2	South Bend	50
Scott	1	Austin	25
	2	Blocher	100
	3	Hardy	....
	4	Lexington	200
	5	Scottsburg	17 100
	6	Vienna	100
Shelby	1	Fairland	50
	2	Morristown	25
	3	Shelbyville	50
	4	Waldron	25
Spencer	1	Buffaloville	100
	2	Chrisney	200
	3	Dale	200
	4	Evanston	2 100
	5	Gentryville	40
	6	Huff	50
	7	Lamar	100
	8	Lincoln City	3 50
	9	Madrid	....
	10	Mariah Hill	50
	11	Pigeon	25
	12	Rockhill	50
	13	Rockport	50
	14	Santa Claus	100
	15	Schley	25
	16	St. Meinard	100
	17	Liberal	....
Starke	1	Hamlet	20
	2	Knox	....
	3	North Judson	....
	4	San Pierre	25
Steuben	1	Angola	....
Sullivan			....
Switzerland	1	Bennington	50
	2	Florence	50
	3	Moorefield	100
	4	Mt. Sterling	50
	5	Patriot	....
	6	Quercus Grove	25
	7	Sugar Branch	100
	8	Vevay	16 100
	9	Center Square	100
	10	E. Enterprise	100
	11	Jay	50
	12	Pleasant	50
Tippecanoe	1	LaFayette	50
Tipton	1	Sharpsville	....
	2	Tipton	....
Union	1	Billingsville	100
	2	Cottage Grove	50
	3	Kitchels	200
	4	Liberty	16 200
	5	Brownsville	40

LIST OF TOWNS—Continued.

County	No. Town on Map	Name of Town	Estimated Sales per Year in Tons
Union	6	Carl	40
	7	College Corner	....
Vanderburg	1	Evansville ...9	500
	2	Englefield	100
	3	Stacer	50
Vermillion	1	Newport	....
Vigo	1	Youngstown	....
Wabash	1	N. Manchester	20
	2	Wabash	40
Warren	..	.....	....
Warrick	1	Boonville 13	400
	2	Chandler	100
	3	Degonia Spr'gs	100
	4	Elberfeld	200
	5	Folsomville	50
	6	Selvin	50
Warrick	7	Tennyson	50
Washington	1	Campbellsb'rg	200
	2	Claysville	50
	3	Fredricksburg	50
	4	Harrisontown	50
	5	Hitchcock	50
	6	Little York	50
	7	Martinsburg	100
	8	New Pn'delp'a.	50
	9	Pekin	100
	10	Salem.....15	800
	11	Saltillo	100
	12	South Boston	50
	13	Wiertown	50
	14	Beck Mills	100
Wayne	1	Boston	50
	2	Cambridge C'y	25
	3	Centerville ..14	50
	4	Dublin	25
	5	E. Germanto'n	25
Wayne	6	Economy	....
	7	Fountain City	....
	8	Greenfork	25
	9	Hagerstown ..2	100
	10	Milton	50
	11	Richmond	200
	12	Williamsburg	....
	13	Abington	....
	14	Whitewater	....
	15	Bethel	60
Wells	1	Bluffton	....
White	1	Brookston	20
	2	Burnetts Creek	....
	3	Lee	20
	4	Monon	75
	5	Monticello	50
	6	Reynolds	60
	7	Wolcott	80
Whitely	1	Columbia City	....

a 40 tons in 1900. No. sales reported in recent years.
1 Distributing point estimated 900 tons received per year.
2 Distributing point estimated 200 tons received per year.
3 Distributing point estimated 150 tons received per year.
4 Distributing point estimated 600 tons received per year.
5 Distributing point estimated 40 tons received per year.
6 Distributing point estimated 75 tons received per year.
7 Distributing point estimated 700 tons received per year.
8 Distributing point estimated 25 tons received per year.
9 Distributing point estimated 1000 tons received per year.
10 Distributing point estimated 300 tons received per year.
11 Distributing point estimated 250 tons received per year.
12 Distributing point estimated 1200 tons received per year.
13 Distributing point estimated 800 tons received per year.
14 Distributing point estimated 100 tons received per year.
15 Distributing point estimated 2000 tons received per year.
16 Distributing point estimated 500 tons received per year.
17 Distributing point estimated 400 tons received per year.
18 Distributing point estimated 50 tons received per year.

RAW MATERIALS FOR HOME MIXING.

In some sections of the State farmers wish to make mixtures that are not on sale in their locality or to do home mixing to duplicate brands that are on sale. Farmers report a considerable saving and satisfactory results from this work. Home mixing is generally on a cash basis, while most of the mixed goods are sold on long time. If the whole business was on a cash basis it would result in a great saving to the consumer.

Those who wish to try home mixing should remember that the raw materials for home mixing require to be registered and guaranteed just as any other fertilizer. Formerly it was difficult to obtain raw materials, but now some of the largest firms have registered raw materials and made them available to farmers.

Farmers and dealers handling raw material should remember that home-mixing should really be done at home and from registered and labeled goods. A dealer who mixes registered raw materials and delivers the mixture to his customer thereby makes a new brand and unless it is registered and labeled, both dealer and buyer may be subjected to penalties. On the other hand the law expressly provides that a farmer may take home and mix any registered raw materials in any way

he may choose. This distinction may seem at first rather unnecessary, but it is a proper one to make. Some of the worst swindling we have ever found in the fertilizer business was in connection with dealers who pretended to mix goods to order.

It is well known that most manufacturers do not wish to sell raw material and hence the registration of raw materials by a considerable number of firms must be considered as something of a concession to the growing demand. It is only fair that those in need of raw material should show some appreciation of this and purchase only registered raw material.

In planning the purchase of raw materials farmers should keep in mind that while potash salts and nitrate of soda are very constant in composition, tankage is a term that is applied to products of very varying composition. Therefore the guarantee on the tankage should be carefully examined, for some kinds of tankage contain three times as much nitrogen as other kinds. As a rule the higher the nitrogen the lower the phosphoric acid in tankage. The phosphoric acid in tankage has practically the same value as that in bone.

The following firms have registered raw materials, furnishing potash and nitrogen. Nearly every house sells ground bone and acid phosphate, so that these materials are not included in the special list given below. The names of the different firms selling this class of material can be determined by referring to Table 3 in the back part of this bulletin. Acid phosphate is often sold under a special brand name, but it can be readily recognized by its guarantee, which should be not less than 12 per cent. of soluble and reverted phosphoric acid. Most of the acid phosphate contains more than this and a 14 per cent. guarantee is very common and the inspections show that it is well maintained.

Muriate of Potash.

Armour Fertilizer Works, The, Chicago, Ill.
Bowker Fertilizer Co., Cincinnati, Ohio.
Cincinnati Phosphate Co., Cincinnati, Ohio.
Farmers Fertilizer Co. Indianapolis, Ind.
Fox Chemical Co., Louisville, Ky.
Hopkins Fertilizer Co., New Albany, Ind.
Hubbell & Son Fertilizer Co., The L. W., Francesville, Ind.
Louisville Fertilizer Co., Louisville, Ky.
North Western Fertilizing Co., Chicago, Ill.
Read Phosphate Co., Nashville, Tenn.
Smith Agricultural Chemical Co., Columbus, Ohio.
Southern Indiana Fertilizer Co., Boonville, Ind.
Swift & Company, Chicago, Ill.
Weidman, Augustus, Hagerstown, Ind.

Sulfate of Potash.

Armour Fertilizer Works, The, Chicago, Ill.
Darling & Company, Chicago, Ill.
Louisville Fertilizer Co., Louisville, Ky.
Rauh & Sons' Fertilizer Co., E., Indianapolis, Ind.

Kainit.

Armour Fertilizer Works, The, Chicago, Ill.
Bash Packing Co., Fort Wayne, Ind.
Hubbell & Son Fertilizer Co., The L. W., Francesville, Ind.
Tuscarora Fertilizer Co., Chicago, Ills.

20% Manure Salt.

Read Phosphate Co., Nashville, Tenn.

Nitrate of Soda.

Armour Fertilizer Works, The, Chicago, Ill.
Bash Packing Co., Fort Wayne, Ind.
Cincinnati Phosphate Co., Cincinnati, Ohio.
Louisville Fertilizer Co., Louisville, Ky.
Rauh & Sons Fertilizer Co., E., Indianapolis, Ind.
Read Phosphate Co., Nashville, Tenn.
Smith Agricultural Chemical Co., The, Columbus, Ohio.
Weidman, Augustus, Hagerstown, Ind.

Tankage.

Cincinnati Phosphate Co., Cincinnati, Ohio.
Louisville Fertilizer Co., Louisville, Ky.
Morris & Co., Nelson, Chicago, Ill.
Smith Agricultural Chemical Co., The, Columbus, Ohio.

Report of Inspections Made During 1904.

During the past year 643 samples of fertilizer were collected by the regular deputies of the State Chemist and analyses of these samples are reported in detail in table 2.

The purpose of this table is to show just what the composition of the goods found at different points was. The label or tag shows what the purchaser is entitled to receive, and the analysis shows what was in the packages to which the labels or tags were attached. The section of the fertilizer law requiring every sample bottle of fertilizer to bear the same label that will appear on the goods when delivered to the purchasers is something of an innovation in fertilizer legislation. In practice it has been found to work admirably and to remove a source of friction between buyer and seller.

Table III contains a list of fertilizers registered and on sale in Indiana, May 1, 1905, so far as it is possible to make such a list. A letter was sent to each manufacturer asking him to indicate any registered brands that were no longer on sale. As a result a considerable number of registered brands have been removed from the list issued in 1904. The brands removed are those which manufacturers stated they would no longer place on sale.

A summary of the results of the inspection during 1904 as compared with those of 1901, 1902 and 1903 can be seen by referring to the following table:

Summary of Inspections for the Past Four Years.

	1901	1902	1903	1904
1. No. of samples collected	592	679	674	643
2. No. equal to legal guarantee in every particular	281	335	286	248
3. No. equal to legal guarantee in value	469	564	492	451
4. No. within 10% of value of legal guarantee	85	93	139	148
5. No. not within 10% of value of legal guarantee	38	22	43	44
6. No. in which one or more ingredient was 20% or more below legal guarantee	103	112	138	122

It will be seen by referring to the above summary and table I on pages 16 and 17, that no improvement has been made over the poor showing of the two years previous, 30 per cent. of the brands inspected falling below the guarantee in value of plant food contained. This means that in many instances the farmer is not getting what he is paying for and what he has a right to expect in his fertilizer. This is not as it should be. It will be noticed by referring to section 4 of the Fertilizer Law that there is a penalty provided for the sale of fertilizers below the legal guarantee in composition.

While it is recognized that the nature of the ingredients used in the manufacture of fertilizers is such as to render thorough mixing difficult, and that consequently some variation from the legal guarantee in composition may be expected, still it is nevertheless certainly true that a greater number than 70 per cent. should be up to the standard in total value of the ingredients contained, and none should show a deficiency of more than 20 per cent. in any one ingredient. It is believed that a large majority of the firms selling fertilizers in the state are attempting to comply with the law in regard to the composition of their goods and that they are doing so as nearly as can reasonably be expected. The analyses show, however, that there are a few firms whose goods, on the average, are so far below the legal standard as to indicate either gross carelessness or an attempt to defraud.

By referring to table I it will be seen that the goods of several firms were found to be badly below the guarantees. In some cases it will be observed as many as one-half the brands on sale fell below the guarantees in value of plant food contained. In one or two cases this averaged over 20 per cent.

The facts are given in the bulletin and it is for the farmers to say whether they will continue to lose money by buying from firms whose goods are constantly badly below the legal standard in composition or buy from firms whose goods are uniformly found to contain the amounts of plant food guaranteed to be present.

Manufacturers are supposed to know the composition of the fertilizers they offer for sale and they are at liberty to make any guarantee that they may desire. But after the guarantee is made it is no hardship to require them to adhere to the guarantee closely enough so that the essential character of a brand is maintained and the value of the goods shall not fall below the value of the guarantee. Where one ingredient is low on account of imperfect mixing, other ingredients should be correspondingly high and such samples would appear under line 3 in the above summary as equal to the legal guarantee in value. Line 4 shows that there are some samples in which the purchaser would not receive what he is entitled to receive, but in our opinion the deficiency is not large enough to indicate a deliberate intent to defraud. When goods fall into the class shown in line 5 it must be considered due to inexcuable carelessness, gross ignorance, or an intent to defraud. Whatever may be the cause, farmers cannot afford to take chances on this class of goods, since the deficiencies sometimes amount to more than half the value of the goods.

The goods under line 6 are those in which the mixing is so bad that the essential character of the brand is changed. Sometimes the goods in this class, while containing less than four-fifths as much of one ingredient as they are guaranteed to contain, have enough of another ingredient to make the value of the goods as great as required by the guarantee. But even these samples show such bad mixing that the essential character of the brand is changed. When a purchaser contracts for goods containing 3 per cent. of potash and 9 per cent. of soluble and reverted phosphoric acid the contract cannot be filled by furnishing goods with 1 per cent. of potash and 11 per cent. of soluble and reverted phosphoric acid, even though the nominal commercial value of the two kinds of goods might not be very different.

It was hoped that the improvement in the mixing in 1904 would be such that line 6 in the summary on pages 16 and 17 might be omitted, but in a number of cases the mixing is so bad that we have deemed it but fair to manufacturers who maintain their guarantees, and to consumers, to call attention to such cases by adding lines 7 and 8.

Necessity for Registering Special Brands.

Many inquiries are received regarding the necessity for registering fertilizer mixed for special purposes and to special order. By referring to Section 1 of the Indiana Ferilizer Law, page 4, it will be seen that no exceptions are made and in every case a certificate containing the name of the manufacturer, the location of the principal office of the manufacturer, the name under which the fertilizer will be sold, the names of the towns in Indiana in which it will be offered for sale, and the minimum guarantee must be filed for registration with the State Chemist.

In failing to register special mixtures manufacturers not only place their agents in position to be prosecuted, but their customers as well, since it is a violation of the Indiana Fertilizer Law to have untagged fertilizer in one's possession. Consumers are therefore cautioned not to accept any fertilizer which does not have attached to each and every package the label of the State Chemist.

Under the working regulations of this office the registration of a certificate is permanent and the guarantee for a brand cannot be changed.

Alteration of Tags.

In two cases the past year shipments were found where the percentage of one or more ingredients as shown on the State Chemist's label was changed, the original guarantee being marked over with figures in red ink. In one case the per cent. of potash, as registered, was 1.1 per cent. while the company sold the brand to the consumer with the understanding that it would contain 5 per cent of potash and marked this number over the 1.1 per cent. on the tag, as originally issued. In the second case the 1.5 per cent. of potash guaranteed was marked over by the figure 5 in red ink. Such use of the State Chemist's name and title is a clear violation of section 4, of the Fertilizer Law, page 4.

The manufacturer also violated Section 1 in not registering a certificate giving the minimum guarantee as 5 per cent. of potash. Had such a certificate been presented for registration the fertilizer would necessarily have been registered under a different name from that on the labels which were attached to the bags in the shipments found.

In the second place the consumer must remember that the guarantee for a brand is permanent and the manufacturer cannot be held to verbal promises. In the cases mentioned the guarantee on one shipment was,—

0.0 per cent. of nitrogen.

1.1 per cent. of potash soluble in water.

10.0 per cent. of soluble and reverted phosphoric acid and

1.0 per cent. of insoluble phosphoric acid,

while the manufacturer agreed in the contract to furnish.

0.0 per cent. of nitrogen.

5.0 per cent. of potash soluble in water.

10.0 per cent. of soluble and reverted phosphoric acid and

1.0 per cent. of insoluble phosphoric acid.

The analyses of three samples drawn from different portions of the shipment gave respectively,—

	(1)	(2)	(3)	Aver-age
Per cent. of nitrogen	0.46	0.35	0.20	0.34
Per cent. of potash soluble in water	1.85	2.24	3.94	2.68
Per cent. of soluble and reverted phosphoric acid	8.22	9.65	5.78	7.88
Per cent. of insoluble phosphoric acid	5.30	3.87	3.46	4.21

Showing conclusively that the manufacturer not only did not keep his verbal promise but furnished a fertilizer of entirely different composition and not even up to the legal guarantee.

In the second shipment the legal guarantee for the brand was,

1.7 per cent. of nitrogen, (N).

1.5 per cent. of potash, (K_2O), soluble in water.

8.0 per cent. of soluble and reverted phosphoric acid, (P2O5), and

2.2 per cent. of insoluble phosphoric acid, (P2O5),

while the manufacturer through his agent contracted to furnish a fertilizer with the above percentages of nitrogen, phosphoric acid, and 5 per cent of potash.

An analysis of a sample drawn from this shipment gave

0.89 per. cent of nitrogen, (N).

4.03 per cent. of of potash, (K_2O), soluble in water,

5.16 per cent of soluble and reverted phosphoric acid, (P2O5), and

3.46 per cent. of insoluble phosphoric acid, (P2O5).

In neither case did the manufacturer keep his contract or even maintain the legal guarantee for the brands. Not only is such change in the label a violation of the law and an injustice to the consumer, but also an injustice to the manufacturer who obeys the law in every particular, and in accepting such shipments consumers are encouraging manufacturers to violate the provisions of the fertilizer law which was put in force for their protection.

The case mentioned has been reported to the prosecutor of the county in which the sale was made and is now before the court of that county.

The State Chemist's labels are always printed and manufacturers in changing the figures thereon are violating the law. Consumers should refuse to accept any fertilizer with such changed tags attached or any fertilizer which does not bear the State Chemist's label showing that the minimum percentages purchased are on a certificate registered with the State Chemist.

Sale of Untagged Goods.

Two cases where tags were not attached to the bags as required by law were successfully prosecuted during the year and our deputies have been instructed to file affidavits in every case where such violation of the law is found.

Consumers should take special note of this section of the law, since for having such untagged fertilizer in their possession they are liable to the same penalty as the manufacturer, agent or dealer, who offers it for sale.

Prices Used in Valuation of Fertilizers.

In computing the comparative value of fertilizers we have used the following rates:

Nitrogen 17½ cents per pound.

Potash 6 cents per pound.

Soluble and reverted phosphoric acid 6 cents per pound.

In bone and tankage, total phosphoric acid 3½ cents per pound.

In mixed goods containing nitrogen, insoluble phosphoric acid 2 cents per pound.

In goods containing no nitrogen no value is given to insoluble phosphoric acid.

If one wishes to use the unit system, that is, the value of each 1 per cent of each ingredient, these values become:

Nitrogen $3.50 per unit.

Potash $1.20 per unit.

Soluble and reverted phosphoric acid $1.20 per unit.

Phosphoric acid in bone $0.70 per unit.

Insoluble phosphoric acid in mixed goods containing nitrogen $0.40 per unit.

It must be kept in mind that these rates are not used for the purpose of indicating the agricultural value of the fertilizer, or the return which may be expected from the use of the fertilizer. This matter is controlled by the soil, season, kind of crop and method of applying the fertilizer. Neither do we attempt to indicate the exact value at which every fertilizer ought to be sold at every point in the State, nor to take into account the long credits often extended to purchasers of fertilizers. We use these rates solely for the purpose of comparing the value of the goods as guaranteed by the manufacturer with the value of the samples we collect in the open market. Purchasers may find these rates of use in comparing the relative values of similar brands of goods offered by different manufacturers.

The following tables show results of analyses of samples collected during 1904, lists of brands legally on sale in the state and manufacturers of same:

TABLE 1. Summary of the Results of Inspection.

MANUFACTURER.	No. of Samples Collected.	No. Equal to Guarantee in Every Particular.	No. Equal in Value to Guarantee.	No. Within 10 Per Cent. of Value of Guarantee.	No. Not Within 10 Per Cent. of Value of Guarantee.	No. With 1 or more ingredient 20 Per cent below Guarantee	No. with 1 or more ingredient 30 per cent below Guarantee.	No. with 1 or more ingredient 50 per cent below Guarantee.
Abbott & Martin Rendering Co., The	10	1	6	3	1	5	3	1
Akin Fertilizer Co	3	2	3	.....	0	1	0	0
American Agricultural Chemical Co., The	41	14	32	8	1	2	1	0
American Agricultural Chemical Co., (The) Great Eastern Fertilizer Branch	3	2	3	.....	0	0	0	0
M. E. Wheeler & Co., Branch of the American Agricultural Chemical Co	10	5	7	3	0	0	0	0
Anderson Fertilizing Co	1	0	1	.....	0	1	0	0
Armour Fertilizer Works, The	26	16	26	.....	0	1	1	0
Bash Packing Co	11	1	1	5	5	7	6	0
Bausback & Sons, Robert	2	2	2	.....	0	0	0	0
Bolles W. R	1	1	1	.....	0	0	0	0
Bowker Fertilizer Co	21	7	10	10	1	0	0	0
Buckeye Fertilizer Co	3	0	3	.....	0	1	0	0
Buhner, Ferdinand	5	4	5	.....	0	0	0	0
Chicago Fertilizer Co., The	7	0	3	4	0	4	3	1
Cincinnati Phosphate Co., The	26	9	13	13	0	3	1	0
Continental Fertilizer Co	7	2	6	.....	1	1	1	0
Corya, J. W	2	1	1	1	0	1	0	0
Currie Fertilizer Co., The	7	5	6	1	0	0	0	0
Darling & Company	14	8	14	.....	0	0	0	0
D. & K. Fertilizer Company	6	2	5	1	0	2	2	1
Empire Carbon Works	1	0	1	.....	0	0	0	0
Empire Guano Co., The	6	0	0	5	1	0	0	0
Ewing, Geo. M	5	4	5	.....	0	0	0	0
Farmers Fertilizer Co	19	8	18	1	0	3	2	0
Fox Chemical Co	18	6	14	3	1	1	0	0
Globe Fertilizer Co	33	14	26	5	2	5	3	0
Hardy Packing Co	4	1	2	2	0	2	1	1
Hess & Bro., S. M	5	3	4	1	0	0	0	0

Summary of Results of Inspection—Concluded.

MANUFACTURER.	No of Samples Collected.	No. Equal to Guarantee in Every Particular.	No. Equal in Value to Guarantee.	No. Within 10 Per Cent. of Value of Guarantee.	No. Not Within 10 Per Cent. of Value of Guarantee.	No. With 1 or more ingredient 20 Per cent below Guarantee	No. with 1 or more ingredient 30 per cent below Guarantee.	No. with 1 or more ingredient 50 per cent below Guarantee.
Hopkins & Co., A	2	0	0	0	2	2	1	1
Hopkins Fertilizer Co	11	0	1	8	2	5	1	0
Hubbell & Son Fertilizer Co., L. W	4	3	3	1	0	0	0	0
Indianapolis Fertilizer Co	1	0	1	.....	0	1	1	1
Indianapolis Rendering Co	16	2	13	1	2	5	1	1
Jarecki Chemical Co	13	4	6	6	1	4	1	0
Johnson, D. B	2	1	1	0	1	1	0	0
Jones' Fertilizer Co., Louisville and Cincinnati	8	3	6	2	0	0	0	0
Jones, J. B	1	0	0	0	1	1	1	0
Jones, Robin	1	1	1	.....	0	0	0	0
Kaufman Fertilizer Co	16	0	2	5	9	12	9	9
Lister, Joseph	1	0	1	.....	0	0	0	0
Louisville Fertilizer Co	14	2	10	3	1	2	1	0
Madison Fertilizer and Glue Works	2	0	0	1	1	2	2	0
Mathiason M'f'g. Co., P. B	2	1	1	1	0	1	0	0
Mayer M'f'g. Co., A. B	4	2	4	.....	0	1	0	0
Mendenhall & Spillman	1	0	0	1	0	0	0	0
Mertz, Thomas	1	1	1	.....	0	0	0	0
Michigan Carbon Works	15	8	12	1	2	2	0	0
Morris & Co., Nelson	14	8	12	2	0	0	0	0
[2]McCallum & Co., Jas	8	3	5	3	0	3	3	0
National Fertilizer Co	7	5	7	.....	0	1	0	0
Norris Fertilizer Co	15	10	14	1	0	0	0	0
Northwestren Fertilizing Co	21	11	17	4	0	0	0	0
Ohio Farmers' Fertilizer Co	9	1	4	4	1	7	5	3
Packers' Fertilizer Association	15	8	10	5	0	0	0	0
Packers' Fertilizer Co., (Cincinnati and St. Bernard.)	15	1	8	6	1	7	2	0
Packer Fertilizer Co., (Indianapolis)	9	3	7	2	.....	2	2	0
Pero & Stoecker	3	2	3	.....	0	0	0	0
Rauh & Sons Fertilizer Co., E	23	7	19	1	3	7	2	1
Read Phosphate Co.,	13	8	11	1	1	2	1	0
Schmadel, Louis	3	0	3	.....	0	1	0	0
Southern Indiana Fertilizer Co	4	1	1	3	0	1	0	0
Star Tankage & Fertilizer Works	3	2	2	1	0	0	0	0
St. John, Chas. E	1	1	1	.....	0	0	0	0
Swift & Company	21	9	14	6	1	3	2	1
Tennessee Fertilizer Co	14	4	8	6	0	1	0	0
Tuscarora Fertilizer Co	15	11	13	2	0	0	0	0
Walton Fertilizer Co., The	1	0	1	.....	0	1	0	0
Weidman, Augustus	3	2	2	1	0	0	0	0
Western Fertilizer Works	6	3	5	1	0	2	1	0
Wuichet Fertilizer Co., The	8	2	3	3	2	5	5	0
Totals	643	248	451	148	44	122	65	21

[1]Includes results of inspection of the Buckeye Phosphate Co., brands.

[2]Manufactured and sold by The Wuichet Fertilizer Co., successors to Jas. McCallum & Co.

TABLE 2.—Report of Inspection of Fertilizers Collected in 1904.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Abbott & Martin Rendering Co., The Columbus, Ohio									
Peerless Bone and Potash	2850	.....	.....	Guaranteed	0.4	2.5	8.0	1.0	.....
Peerless Bone and Potash	2850	2911	Bloomington	Found	0.4	2.2	8.5	3.3	.....
Peerless Bone and Potash	2850	2912	Salem	Found	0.3	2.2	7.8	2.1	.....
Peerless Bone and Potash	2850	2913	North Madison	Found	0.3	2.4	7.5	2.3	.....
Harvest King	3210	.....	.....	Guaranteed	1.2	2.0	8.0	1.0	.....
Harvest King	3210	2914	Bloomington	Found	0.5	2.4	8.3	3.1	.....
Abbott's Ideal Grain Grower	3213	.....	.....	Guaranteed	0.8	1.0	7.0	1.0	.....
Abbott's Ideal Grain Grower	3213	2915	Bloomington	Found	0.7	1.1	8.0	3.9	.....
Abbott's Ideal Grain Grower	3213	2916	Salem	Found	0.5	0.6	8.1	2.3	.....
Fine Raw Bone Meal	3352	.....	.....	Guaranteed	1.2	.....	.....	.....	27.0
Fine Raw Bone Meal	3352	2917	Wirt	Found	0.8	.....	.....	.....	31.1
Tobacco and Potato Special	3419	.....	.....	Guaranteed	1.6	4.0	8.0	1.0	.....
Tobacco and Potato Special	3419	2918	Bloomington	Found	1.7	3.8	9.7	2.7	.....
Hercules Phosphate	3420	.....	.....	Guaranteed	....	.....	14.0	1.0	.....
Hercules Phosphate	3420	2919	Bloomington	Found	....	.....	11.3	7.3	.....
Hercules Phosphate	3420	2920	Salem	Found	....	.....	14.7	2.5	.....
Akin Fertilizer Co., Evansville, Ind.									
Pure Raw Bone	2962	.....	.....	Guaranteed	3.0	.....	.....	.....	20.0
Pure Raw Bone	2962	2921	Evansville	Found	3.7	.....	.....	.....	20.0
Pure Raw Bone	2962	2922	Elberfeld	Found	3.8	.....	.....	.....	20.5
Bone Meal	2976	.....	.....	Guaranteed	1.7	1.2	11.0	5.0	.....
Bone Meal	2976	2923	Evansville	Found	1.3	1.0	13.3	3.4	.....
Anderson Fertilizing Co., Anderson, Ind.									
A Soft Bone Fertilizer	3317	.....	.....	Guaranteed	4.0	.....	.....	.....	17.0
A Soft Bone Fertilizer	3317	2924	Anderson	Found	3.0	.....	.....	.....	23.0
American Agricultural Chemical Co., The New York, N. Y.									
Cleveland Dryer, Tobacco, Potato and General Crop Fertilizer	2800	.....	.....	Guaranteed	0.8	4.0	10.0	.....	.....
Cleveland Dryer, Tobacco, Potato and General Crop Fertilizer	2800	2925	New Albany	Found	1.2	2.6	8.1	2.1	.....
Cleveland Dryer Phospho Bone	2802	.....	.....	Guaranteed	0.8	1.0	10.0	.....	.....
Cleveland Dryer Phospho Bone	2802	2926	Connersville	Found	1.0	1.2	9.3	2.4	.....
Cleveland Dryer XXX Superphosphate	2803	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Cleveland Dryer XXX Superphosphate	2803	2927	Connersville	Found	....	.....	13.6	1.6	.....
Cleveland Dryer Ohio Seed Maker with Potash	2804	.....	.....	Guaranteed	1.6	2.0	8.0	.....	.....
Cleveland Dryer Ohio Seed Maker with Potash	2804	2928	Weisburg	Found	1.8	2.1	8.2	3.9	.....
Cleveland Dryer Ohio Seed Maker	2805	.....	.....	Guaranteed	1.6	.....	10.0	.....	.....
Cleveland Dryer Ohio Seed Maker	2805	2929	Connersville	Found	1.6	.....	8.5	3.4	.....
Cleveland Dryer Forest City Buckeye Ammoniated Bone Superphosphate	2806	.....	.....	Guaranteed	2.4	2.0	9.0	.....	.....
Cleveland Dryer Forest City Buckeye Ammoniated Bone Superphosphate	2806	2930	Elkhart	Found	2.2	2.0	9.7	4.3	.....
Zell's Little Giant	2807	.....	.....	Guaranteed	0.8	1.0	7.0	.....	.....
Zell's Little Giant	2807	2931	Bedford	Found	0.9	0.9	6.4	2.2	.....
Zell's Dissolved S. C. Phosphate	2808	.....	.....	Guaranteed	....	.....	12.0	.....	.....
Zell's Dissolved S. C. Phosphate	2808	2932	Bloomington	Found	....	.....	12.8	4.9	.....
Zell's Dissolved Bone Phosphate	2809	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Zell's Dissolved Bone Phosphate	2809	2933	Bloomington	Found	....	.....	14.0	3.0	.....
Zell's Economizer	2811	.....	.....	Guaranteed	0.8	2.0	8.0	.....	.....
Zell's Economizer	2811	2934	Bloomington	Found	1.0	2.2	8.2	2.4	.....
Bradley's Corn and Wheat Phosphate	2813	.....	.....	Guaranteed	0.8	1.0	10.0	.....	.....
Bradley's Corn and Wheat Phosphate	2813	2935	Zanesville	Found	1.2	1.3	9.3	3.4	.....
Bradley's Corn and Wheat Phosphate	2813	2936	Bedford	Found	0.9	1.2	10.0	2.0	.....
Bradley's B. D. Sea Fowl Guano	2814	.....	.....	Guaranteed	2.0	1.5	8.0	.....	.....
Bradley's B. D. Sea Fowl Guano	2814	2937	Pekin	Found	2.2	1.6	8.2	3.9	.....
Bradley's Alkaline Bone and Potash	2815	.....	.....	Guaranteed	....	2.0	10.0	.....	.....
Bradley's Alkaline Bone and Potash	2815	2938	Corydon Junc	Found	....	1.7	9.8	1.3	.....
Bradley's Alkaline Bone and Potash	2815	2939	Corydon	Found	....	1.8	9.7	1.4	.....
Bradley's Alkaline Bone and Potash	2815	2940	St. Joe Station	Found	....	1.9	10.3	1.5	.....
Bradley's Dissolved Bone with Potash	2816	.....	.....	Guaranteed	1.0	2.0	8.0	.....	.....

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
American Agricultural Chemical Co., The New York, N. Y.									
Bradley's Dissolved Bone with Potash..	2816	2941	Corydon Junc	Found.....	1.0	2.1	7.3	2.4	.....
Bradley's Dissolved Bone with Potash..	2816	2842	St. Joe Station	Found.....	1.5	2.0	7.3	5.5	.....
Bradley's Dissolved Bone with Potash..	2816	2943	Bedford	Found.....	1.1	1.7	8.0	4.8	.....
Bradley's Niagara Phosphate.....	2817	.....	.....	Guaranteed	0.8	1.0	7.0	.....	.....
Bradley's Niagara Phosphate.....	2817	2944	Corydon Junc	Found.....	0.8	1.2	6.6	2.7	.....
Bradley's Niagara Phosphate.....	2817	2945	Corydon	Found.....	1.0	1.0	7.4	2.7	.....
Bradley's Niagara Phosphate.....	2817	2846	St. Joe Station	Found.....	0.9	0.8	6.5	2.2	.....
Bradley's Potato and Root Phosphate..	2819	.....	.....	Guaranteed	0.8	4.0	8.0	.....	.....
Bradley's Potato and Root Phosphate..	2819	2947	Corydon Junc	Found.....	0.9	3.8	7.2	2.2	.....
Bradley's Potato and Root Phosphate..	2819	2948	Pekin	Found.....	1.1	3.8	7.4	3.2	.....
Bradley's Soluble Dissolved Bone.....	2821	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Bradley's Soluble Dissolved Bone.....	2821	2949	Salem	Found.....	....	.....	12.4	1.1	.....
Bradley's Soluble Dissolved Bone.....	2821	2950	Pekin	Found.....	....	.....	14.2	1.7	.....
Cumberland Dissolved Bone Phosphate..	2822	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Cumberland Dissolved Bone Phosphate..	2822	2951	Taswell	Found.....	....	.....	13.5	3.1	.....
Cumberland Guano.....	2824	.....	.....	Guaranteed	1.0	2.0	8.0	.....	.....
Cumberland Guano.....	2824	2952	Madison	Found.....	1.0	2.1	7.4	2.3	.....
Cumberland Guano.....	2824	2953	Spencer	Found.....	1.2	1.9	7.8	5.1	.....
Cumberland Hawkeye Fertilizer.....	2825	.....	.....	Guaranteed	0.8	1.0	7.0	.....	.....
Cumberland Hawkeye Fertilizer.....	2825	2954	Leipsic	Found.....	0.8	1.1	8.0	1.6	.....
Cumberland Hawkeye Fertilizer.....	2825	2955	Spencer	Found.....	0.9	0.9	6.6	2.4	.....
Cumberland Acid Phosphate.....	2826	.....	.....	Guaranteed	....	.....	10.0	.....	.....
Cumberland Acid Phosphate.....	2826	2956	Spencer	Found.....	....	.....	9.6	2.2	.....
Cumberland Potato Phosphate.....	2827	.....	.....	Guaranteed	0.8	4.0	8.0	.....	.....
Cumberland Potato Phosphate.....	2827	2957	Georgetown .	Found.....	0.9	4.0	7.1	2.3	.....
Ground Bone.....	2870	.....	.....	Guaranteed	2.4	.....	.....	.....	20.0
Ground Bone	2870	2958	Bedford	Found.....	2.0	.....	.....	.....	21.3
Standard "A" Brand.....	2872	.....	.....	Guaranteed	0.8	1.0	7.0	.....	.....
Standard "A" Brand.....	2872	2959	Georgetown .	Found.....	0.8	1.2	6.6	3.0	.....
Standard Ammoniated Dissolved Bone..	2873	.....	.....	Guaranteed	1.6	2.0	8.0	.....	.....
Standard Ammoniated Dissolved Bone..	2873	2960	Sellersburg .	Found.....	1.9	2.2	8.3	4.4	.....
Standard Guano.....	2874	.....	.....	Guaranteed	1.0	2.0	8.0	.....	.....
Standard Guano.....	2874	2961	Georgetown ..	Found.....	1.1	2.0	7.7	2.3	.....
Standard Guano.....	2874	2962	Corydon	Found.....	1.2	2.0	8.0	3.9	.....
Standard Dissolved Bone Phosphate.....	2883	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Standard Dissolved Bone Phosphate.....	2883	2963	Mitchell	Found.....	....	.....	14.0	1.3	.....
Special Bone Meal.....	3600	.....	.....	Guaranteed	1.2	.....	.....	.....	25.0
Special Bone Meal.....	3600	2964	Bloomington	Found.....	1.3	.....	.....	.....	26.5
Special Bone Meal.....	3600	2965	Bedford	Found.....	1.6	.....	.....	.....	25.9
American Agricultural Chemical Co., (The) Great Eastern Fertilizer Branch, Rutland, Vt.									
Great Eastern English Wheat Grower..	3451	.....	.....	Guaranteed	0.8	2.0	8.0	1.0	.....
Great Eastern English Wheat Grower..	3451	2966	Osgood	Found.....	1.0	2.0	7.4	3.9	.....
Great Eastern Soluble Bone and Potash	3453	.....	.....	Guaranteed	....	2.0	10.0	1.0	.....
Great Eastern Soluble Bone and Potash	3453	2967	Osgood	Found.....	....	2.0	11.5	1.8	.....
Great Eastern Unammoniated Wheat Special	3456		.....	Guaranteed	....	.....	12.0	2.0	.....
Great Eastern Unammoniated Wheat Special	3456	2968	Osgood	Found.....	....	.....	12.9	3.6	.....
M. E. Wheeler & Co., Branch of The American Agricultural Chemical Co., New York, N. Y.									
Wisdom's Choice.....	3092	.....	.....	Guaranteed	....	.....	10.0	2.0	.....
Wisdom's Choice.....	3092	2969	French Lick.	Found.....	....	.....	9.3	4.3	.....
Wisdom's Choice.....	3092	2970	Sunman	Found.....	....	.....	10.8	3.9	.....
Electrical Dissolved Bone	3094	.....	.....	Guaranteed	....	.....	14.0	2.0	.....
Electrical Dissolved Bone.....	3094	2971	Bloomington	Found.....	....	.....	13.1	3.3	.....
Electrical Dissolved Bone.....	3094	2972	Elberfeld	Found.....	....	.....	14.3	1.5	.....
Wheat and Clover Fertilizer.....	3095	.....	.....	Guaranteed	....	2.0	10.0	1.0	.....
Wheat and Clover Fertilizer.....	3095	2973	Weisburg ...	Found.....	....	2.0	9.8	4.5	.....
Royal Wheat Grower.....	3096	.....	.....	Guaranteed	0.8	2.0	8.0	1.0	.....
Royal Wheat Grower.....	3096	2974	Corydon Junc	Found.....	1.0	2.1	8.2	2.6	.....
Royal Wheat Grower.....	3096	2975	Knightstown	Found.....	1.1	2.1	7.5	3.8	.....
Royal Wheat Grower.....	3096	2976	Chrisney	Found.....	1.2	1.8	9.6	3.9	.....
Corn Fertilizer.....	3097	.....	.....	Guaranteed	1.6	2.0	8.0	1.0	.....

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
M. E. Wheeler & Co., Branch of The American Agricultural Chemical Co., New York, N. Y.									
Corn Fertilizer	3097	2977	Bloomington	Found	2.0	2.0	8.7	3.7	.....
Potato Manure	3098	.....	.....	Guaranteed	2.0	3.0	8.0	1.0	.....
Potato Manure	3098	2978	Corydon Junc	Found	2.1	3.3	8.8	2.5	.....
Armour Fertilizer Works (The) Chicago, Ill.									
Raw Bone	2903	.....	.....	Guaranteed	3.7	.....	.....	.....	22.0
Raw Bone	2903	2979	Loogootee ..	Found	3.8	.....	.....	.....	25.8
Bone Meal	2904	.....	.....	Guaranteed	2.4	.....	.....	.....	24.0
Bone Meal	2904	2980	Heltonville ..	Found	3.1	.....	.....	.....	25.2
Fruit and Root Crop Special	2906	.....	.....	Guaranteed	1.6	5.0	8.0	2.0	.....
Fruit and Root Crop Special	2906	2981	Eckerty	Found	1.9	5.0	8.8	0.9	.....
Fruit and Root Crop Special	2906	2982	Orleans	Found	2.8	3.0	9.3	1.5	.....
All Soluble	2907	.....	.....	Guaranteed	2.8	4.0	8.0	2.0	.....
All Soluble	2907	2983	Lexington ..	Found	2.8	5.2	6.6	4.1	.....
Star Phosphate	2908	.....	.....	Guaranteed	....	.....	14.0	2.0	.....
Star Phosphate	2908	2984	Salem	Found	....	.....	16.6	0.2	.....
Star Phosphate	2908	2985	Nulltown	Found	....	.....	14.2	0.0	.....
Star Phosphate	2908	2986	Morgantown .	Found	....	.....	16.2	0.1	.....
Phosphate and Potash	2909	.....	.....	Guaranteed	....	2.0	10.0	2.0	.....
Phosphate and Potash	2909	2987	Eckerty	Found	....	3.2	10.2	0.5	.....
Grain Grower	2910	.....	.....	Guaranteed	1.6	2.0	8.0	2.0	.....
Grain Grower	2910	2988	Salem	Found	1.6	2.3	9.3	2.0	.....
Grain Grower	2910	2989	Heltonville ..	Found	1.9	2.4	8.3	2.4	.....
Ammoniated Bone with Potash	2911	.....	.....	Guaranteed	2.4	2.0	6.0	2.0	.....
Ammoniated Bone with Potash	2911	2990	Orleans	Found	2.3	2.5	6.2	3.4	.....
Wheat, Corn and Oat Special	2938	.....	.....	Guaranteed	0.8	1.0	7.0	2.0	.....
Wheat, Corn and Oat Special	2938	2991	Lexington ..	Found	0.8	1.5	7.4	0.9	.....
Wheat, Corn and Oat Special	2938	2992	Orleans	Found	0.9	1.0	7.0	1.5	.....
Bone, Blood and Potash	2958	.....	.....	Guaranteed	4.1	7.0	8.0	2.0	.....
Bone, Blood and Potash	2958	2993	Rushville	Found	4.2	9.0	7.9	0.4	.....
Acid Bone Meal	3020	.....	.....	Guaranteed	1.6	.....	11.0	7.0	.....
Acid Bone Meal	3020	2994	Milton	Found	2.0	.....	11.1	13.2	.....
German Kainit	3312	.....	.....	Guaranteed	....	12.5	.....	.....	.....
German Kainit	3312	2995	Pleasant Ridge	Found	....	12.5	.....	.....	.....
Armour's Steamed Bone	3331	.....	.....	Guaranteed	1.6	.....	.....	.....	20.0
Armour's Steamed Bone	3331	2996	Bath	Found	2.0	.....	.....	.....	25.3
Armour's Steamed Bone	3331	2997	Heltonville ..	Found	2.4	.....	.....	.....	25.4
Muriate of Potash	3477	.....	.....	Guaranteed	....	48.0	.....	.....	.....
Muriate of Potash	3477	2998	Nulltown	Found	....	49.5	.....	.....	.....
Hoosier Corn Grower	3480	.....	.....	Guaranteed	0.8	4.0	8.0	2.0	.....
Hoosier Corn Grower	3480	2999	Lexington ..	Found	1.0	4.1	8.0	0.9	.....
High Grade Potato	3509	.....	.....	Guaranteed	1.6	10.0	8.0	2.0	.....
High Grade Potato	3509	3000	Salem	Found	1.7	11.6	7.3	3.7	.....
Armour's Standard	3510	.....	.....	Guaranteed	0.8	3.0	8.0	2.0	.....
Armour's Standard	3510	3001	Salem	Found	1.2	4.1	9.6	1.7	.....
Armour's Standard	3510	3002	Orleans	Found	1.7	3.8	7.0	3.0	.....
Soluble Phosphate and Potash	3536	.....	.....	Guaranteed	....	4.0	10.0	.....	.....
Soluble Phosphate and Potash	3536	3003	Eckerty	Found	....	4.3	11.3	0.8	.....
Soluble Phosphate and Potash	3536	3004	Oakland City.	Found	....	4.7	10.7	1.1	.....
Bash Packing Co., Fort Wayne, Ind.									
Wayne Raw Bone	2990	.....	.....	Guaranteed	4.0	.....	.....	.....	21.8
Wayne Raw Bone	2990	3005	Ramsey	Found	3.3	.....	.....	.....	18.9
Utility Phosphate	3449	.....	.....	Guaranteed	1.8	1.5	10.5	3.3	.....
Utility Phosphate	3449	3006	Corydon Junc	Found	1.2	1.0	9.2	5.8	.....
Utility Phosphate	3449	3007	Ramsey	Found	1.2	1.4	11.0	3.6	.....
Utility Phosphate	3449	3008	Bloomington	Found	1.1	1.3	8.6	2.9	.....
Bash's Grain Grower	3598	.....	.....	Guaranteed	1.2	2.0	8.0	1.0	.....
Bash's Grain Grower	3598	3009	Salem	Found	1.0	1.6	6.9	1.7	.....
Bash's Grain Grower	3598	3010	Bloomington	Found	0.8	2.2	7.7	1.1	.....
Bash's Potash Special	3599	.....	.....	Guaranteed	....	4.0	10.0	1.0	.....
Bash's Potash Special	3599	3011	Salem	Found	....	2.2	11.6	1.3	.....
Bash's Potash Special	3599	3012	Ramsey	Found	....	2.1	11.2	2.0	.....
Bash's 16% Phosphate	3604	.....	.....	Guaranteed	....	.....	16.0	1.0	.....
Bash's 16% Phosphate	3604	3013	Salem	Found	....	.....	14.1	1.7	.....
Bash's 16% Phosphate	3604	3014	Ramsey	Found	....	.....	15.3	2.2	.....
Bash's 14% Phosphate	3605	.....	.....	Guaranteed	....	.....	14.0	1.0	.....
Bash's 14% Phosphate	3605	3015	Bloomington	Found	....	.....	14.4	1.5	.....

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Bausback & Sons, Rob't. Shelbyville, Ind.									
Sott Bone	3007			Guaranteed	3.5				14.0
Soft Bone	3007	3016	Shelbyville	Found	5.0				16.2
Fine Raw Bone	3008			Guaranteed	3.5				22.0
Fine Raw Bone	3008	3017	Acton	Found	3.6				23.0
Bolles, W. R., Ewing, Ind.									
Bolles Bone Meal	3634			Guaranteed	2.4				24.0
Bolles Bone Meal	3634	3018	Ewing	Found	3.0				26.0
Bowker Fertilizer Co., Boston, Mass.									
Bowker's Bone Meal	2953			Guaranteed	1.5				20.0
Bowker's Bone Meal	2953	3019	Rose Lawn	Found	1.6				21.5
Bowker's Bone Meal	2953	3020	Bedford	Found	1.6				22.2
Bowker's Fish Guano	2954			Guaranteed	0.7	3.0	8.0	1.0	
Bowker's Fish Guano	2954	3021	New Albany	Found	0.9	2.9	8.7	2.9	
Bowker's Fish Guano	2954	3022	Bloomfield	Found	0.8	2.9	8.7	2.1	
Bowker's Dissolved Bone Phosphate	2955			Guaranteed			10.0	1.0	
Bowker's Dissolved Bone Phosphate	2955	3023	Dale	Found			8.8	4.5	
Bowker's Dissolved Bone Phosphate	2955	3024	Ellettsville	Found			9.9	5.8	
Bowker's Dissolved Bone Phosphate	2955	3025	Bedford	Found			9.5	5.6	
Bowker's Soluble Bone	2956			Guaranteed			14.0	1.0	
Bowker's Soluble Bone	2956	3026	Marengo	Found			12.8	3.7	
Bowker's Soluble Bone	2956	3027	Bloomfield	Found			16.0	2.7	
Bowker's Soluble Bone	2956	3028	Degonia	Found			13.2	3.2	
Harvest Bone	3287			Guaranteed	0.7	1.0	8.0		
Harvest Bone	3287	3029	Salem	Found	1.0	1.4	9.0	2.7	
Harvest Bone	3287	3030	Bedford	Found	0.8	1.2	8.5	3.1	
Bowker's Potash Fertilizer	3311			Guaranteed		5.0	10.0	1.0	
Bowker's Potash Fertilizer	3311	3031	Salem	Found		5.1	8.4	3.7	
Bowker's Potash Fertilizer	3311	3032	Bloomfield	Found		4.8	9.5	4.0	
Bowker's Potash Fertilizer	3311	3033	Rushville	Found		4.9	9.8	3.8	
Bowker Fertilizer Co., Cincinnati, Ohio.									
Dissolved Bone with Potash	3459			Guaranteed		2.0	10.0	1.0	
Dissolved Bone with Potash	3459	3034	Dale	Found		2.1	8.7	4.0	
Dissolved Bone with Potash	3459	3035	Bloomfield	Found		1.9	9.4	4.2	
Bowker's 10 Per Cent Manure	3460			Guaranteed	0.7	10.0	5.0	1.0	
Bowker's 10 Per Cent Manure	3460	3036	Rose Lawn	Found	1.1	9.5	5.7	2.5	
Bowker's 10 Per Cent Manure	3460	3037	Dale	Found	0.9	11.0	6.6	1.6	
Bowker's 10 Per Cent Manure	3460	3038	Dale	Found	0.8	11.0	5.7	2.6	
Bowker Fertilizer Co., New York, N. Y.									
Muriate of Potash	3529			Guaranteed		50.0			
Muriate of Potash	3529	3039	Degonia	Found		46.4			
Buckeye Phosphate Co., The Columbus, Ohio.									
Complete Fertilizer	3088			Guaranteed	0.4	2.5	8.0		
Complete Fertilizer	3088	3040	Scottsburg	Found	0.3	2.5	8.3	2.7	
Buckeye Fertilizer Co., The Columbus, Ohio									
Our Special Corn and Wheat Grower	3372			Guaranteed	0.8	1.0	10.0	1.0	
Our Special Corn and Wheat Grower	3372	3041	Scottsburg	Found	0.8	4.1	8.9	1.3	
Special Blood and Potash Mixture	3616			Guaranteed	0.8	4.0	8.0	2.0	
Special Blood and Potash Mixture	3616	3042	Underwood	Found	1.0	3.5	10.4	3.0	
Buhner, Ferdinand, Seymour, Ind.									
Buhner's All Crop Grower	3316			Guaranteed	2.0	1.2	8.0	2.0	
Buhner's All Crop Grower	3316	3043	Seymour	Found	2.3	1.0	13.1	1.4	
Buhner's All Crop Grower	3316	3044	Seymour	Found	2.0	1.6	9.9	8.8	
Ammoniated Ground Bone	3327			Guaranteed	2.0				17.0
Ammoniated Ground Bone	3327	3045	Seymour	Found	3.5				20.2
Buhner's Dissolved Bone	3486			Guaranteed			14.0		
Buhner's Dissolved Bone	3486	3046	Seymour	Found			14.3	2.4	
Buhner's Dissolved Bone	3486	3047	Seymour	Found			16.2	1.2	
Chicago Fertilizer Co., The Chicago, Ills.									
Bone, Blood and Potash	3011			Guaranteed	1.2	2.0	8.0	2.0	
Bone, Blood and Potash	3011	3048	Norris	Found	1.3	2.5	7.6	3.6	

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Chicago Fertilizer Co., The, Chicago, Ills.									
Bone, Blood and Potash	3011	3049	Freetown	Found	0.8	1.8	8.2	2.8	.....
Potato, Truck and Tobacco Fertilizer	3215	.....	.....	Guaranteed	1.6	4.0	8.0	1.0	.....
Potato, Truck and Tobacco Fertilizer	3215	3050	Holton	Found	1.1	4.1	8.8	0.8	.....
Wheat and Corn Special	3216	.....	.....	Guaranteed	0.8	1.0	7.0	1.0	.....
Wheat and Corn Special	3216	3051	Salem	Found	0.4	0.9	9.2	0.8	.....
Chicago Raw Bone	3353	.....	.....	Guaranteed	1.2	.....	.....	.....	27.0
Chicago Raw Bone	3353	3052	Freetown	Found	1.0	.....	.....	.....	33.2
"A" No. 1 Acid Phosphate	3409	.....	.....	Guaranteed	....	.....	10.0	1.0	.....
"A" No. 1 Acid Phosphate	3409	3053	Salem	Found	....	.....	9.4	3.8	.....
Western Bone Black and Potash	3412	.....	.....	Guaranteed	0.4	2.5	8.0	1.0	.....
Western Bone Black and Potash	3412	3054	Freetown	Found	0.3	2.2	7.8	1.6	.....
Cincinnati Phosphate Co., (The) St. Bernard, Ohio									
Capital City Ground Bone	2885	.....	.....	Guaranteed	2.8	.....	.....	.....	20.0
Capital City Ground Bone	2885	3055	Orleans	Found	2.1	.....	.....	.....	27.8
Capital City Wheat Grower	2886	.....	.....	Guaranteed	....	.....	14.0	1.0	.....
Capital City Wheat Grower	2886	3056	Salem	Found	....	.....	14.5	1.3	.....
Capital City Wheat Grower	2886	3057	Franklin	Found	....	.....	14.2	2.4	.....
Capital City Grain and Grass Grower	2887	.....	.....	Guaranteed	0.8	1.0	10.0	1.0	.....
Capital City Grain and Grass Grower	2887	3058	Salem	Found	0.8	1.5	10.3	2.3	.....
Capital City Grain and Grass Grower	2887	3059	Franklin	Found	0.7	1.0	10.7	2.4	.....
Capital City Dissolved Bone and Potash	2888	.....	.....	Guaranteed	....	3.0	12.0	1.0	.....
Capital City Dissolved Bone and Potash	2888	3060	Madison	Found	....	2.0	12.1	2.4	.....
Capital City Dissolved Bone and Potash	2888	3061	Georgetown.	Found	....	2.6	11.7	2.3	.....
Capital City Dissolved Bone and Potash	2888	3062	Liberty	Found	....	2.6	11.9	2.4	.....
Capital City Super Phosphate	2889	.....	.....	Guaranteed	....	.....	12.0	1.0	.....
Capital City Super Phosphate	2889	3063	Salem	Found	....	.....	11.0	2.6	.....
Capitol Muriate of Potash	3322	.....	.....	Guaranteed	....	50.0	.....	.....	.....
Capitol Muriate of Potash	3322	3064	Madison	Found	....	50.2	.....	.....	.....
Capitol Muriate of Potash	3322	3065	Liberty	Found	....	51.8	.....	.....	.....
Capitol Muriate of Potash	3322	3066	Milltown	Found	....	48.1	.....	.....	.....
Capitol Tobacco Food	3224	.....	.....	Guaranteed	0.8	4.0	8.0	1.0	.....
Capitol Tobacco Food	3224	3067	Salem	Found	0.8	4.5	6.5	2.5	.....
Capitol Tobacco Food	3224	3068	Franklin	Found	0.8	3.9	7.7	3.1	.....
Cincinnati Phosphate Co., The Cincinnati, Ohio.									
Capitol Alkaline Bone	3434	.....	.....	Guaranteed	....	2.0	10.0	1.0	.....
Capitol Alkaline Bone	3434	3069	Madison	Found	....	1.5	9.4	3.3	.....
Capitol Alkaline Bone	3434	3070	Franklin	Found	....	2.0	10.0	2.5	.....
Capitol Nitrate of Soda	3506	.....	.....	Guaranteed	13.5	.....	.....	.....	.....
Capitol Nitrate of Soda	3506	3071	Salem	Found	15.2	.....	.....	.....	.....
High Grade Guano	3571	.....	.....	Guaranteed	0.8	2.0	10.0	1.0	.....
High Grade Guano	3571	3072	Salem	Found	0.8	2.4	9.4	2.2	.....
High Grade Guano	3571	3073	Franklin	Found	1.1	2.2	7.8	3.0	.....
Tankage	3625	.....	.....	Guaranteed	8.3	.....	.....	.....	.....
Tankage	3625	3074	Salem	Found	7.8	.....	.....	.....	.....
Tankage	3625	3075	Milltown	Found	8.7	.....	.....	.....	.....
Tankage	3625	3076	Liberty	Found	8.4	.....	.....	.....	.....
Patron's High Grade Phosphate	3626	.....	.....	Guaranteed	....	.....	16.0	1.0	.....
Patron's High Grade Phosphate	3626	3077	Madison	Found	....	.....	14.9	1.8	.....
Patron's High Grade Phosphate	3626	3078	Madison	Found	....	.....	15.4	2.0	.....
Humus Phosphate	3665	.....	.....	Guaranteed	0.4	.....	14.0	1.0	.....
Humus Phosphate	3665	3079	Connersville	Found	0.4	.....	12.5	1.5	.....
Humus Phosphate	3665	3080	Orleans	Found	0.5	.....	12.3	1.0	.....
Continental Fertilizer Co., Nashville, Tenn.									
Bear High Grade Potato and Tobacco Grower	3283	.....	.....	Guaranteed	1.6	4.0	7.0	1.0	.....
Bear High Grade Potato and Tobacco Grower	3283	3081	Alton	Found	1.1	3.5	6.4	1.1	.....
Bear Bone Meal	3300	.....	.....	Guaranteed	0.8	.....	.....	.....	20.0
Bear Bone Meal	3300	3082	Osgood	Found	1.0	.....	.....	.....	19.4
Bear Special Wheat Grower	3328	.....	.....	Guaranteed	0.8	1.0	7.0	1.0	.....
Bear Special Wheat Grower	3328	3083	Cannelton	Found	0.7	1.2	7.5	1.9	.....
Bear Indiana Special Corn Grower	3426	.....	.....	Guaranteed	0.8	1.0	7.0	1.0	.....
Bear Indiana Special Corn Grower	3426	3084	Evansville	Found	0.9	1.4	6.7	1.5	.....
Bear Indiana Special Corn Grower	3426	3085	Evansville	Found	0.9	1.2	7.1	2.1	.....

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Continental Fertilizer Co., Nashville, Tenn.									
Bear Indiana Beef, Blood and Bone....	3427	.....	.....	Guaranteed	1.6	2.0	10.0	1.0	.....
Bear Indiana Beef, Blood and Bone....	3427	3086	Brookville ...	Found.....	1.4	1.7	10.4	2.7	.....
XX Ground Bone.....	3524	.....	.....	Guaranteed	1.2	.....	4.0	11.0	.....
XX Ground Bone.....	3524	3087	Osgood	Found.....	1.8	.....	8.5	9.5	.....
Corya, J. W., North Vernon, Ind.									
Acidulated Bone Meal.....	3357	.....	.....	Guaranteed	2.4	.....	9.0	2.0	.....
Acidulated Bone Meal.....	3357	3088	North Vernon	Found.....	2.4	.....	7.1	7.2	.....
Grain Grower	3358	.....	.....	Guaranteed	....	2.0	10.0	1.0	.....
Grain Grower	3358	3089	North Vernon	Found.....	....	2.1	10.2	0.6	.....
Currie Fertilizer Company, The, Louisville, Ky.									
Currie's Soluble Bone.....	2975	.....	.....	Guaranteed	1.0	1.5	10.0	2.0	.....
Currie's Soluble Bone.....	2975	3090	Evansville ...	Found.....	1.1	1.5	10.6	1.7	.....
Currie's Soluble Bone.....	2975	3091	Troy	Found.....	1.5	1.5	10.6	2.3	.....
Currie's Soluble Bone.....	2975	3092	Evansville ..	Found.....	1.5	1.9	10.0	1.8	.....
Currie's Acid Phosphate.....	3114	.....	.....	Guaranteed	....	.....	13.5	.....	.....
Currie's Acid Phosphate.....	3114	3093	Evansville ..	Found.....	....	.....	16.1	1.6	.....
Currie's Acid Phosphate.....	3114	3094	Evansville ..	Found.....	....	.....	13.2	2.7	.....
Currie's Corn and Wheat Special.....	3116	.....	.....	Guaranteed	0.8	1.0	10.0	2.5	.....
Currie's Corn and Wheat Special.....	3116	3095	Magnet	Found.....	0.9	1.3	10.8	2.1	.....
Currie's Ammoniated Dissolved Bone..	3119	.....	.....	Guaranteed	1.6	2.0	8.0	2.0	.....
Currie's Ammoniated Dissolved Bone..	3119	3096	Leopold	Found.....	1.6	2.3	9.2	2.4	.....
Darling & Company, Chicago, Ills.									
Darling's Ground Raw Bone.....	2843	.....	.....	Guaranteed	3.3	.....	.....	.....	21.0
Darling's Ground Raw Bone.....	2843	3097	Orleans	Found.....	3.9	.....	.....	.....	23.7
Darling's Two and Twenty Bone.....	2844	.....	.....	Guaranteed	1.6	.....	.....	.....	18.0
Darling's Two and Twenty Bone.....	2844	3098	Pierceville ..	Found.....	2.3	.....	.....	.....	17.8
Darling's Chicago Brand.....	2847	.....	.....	Guaranteed	1.6	2.0	8.0	.....	.....
Darling's Chicago Brand.....	2847	3099	Osgood	Found.....	1.7	2.3	7.4	4.4	.....
Darling's Chicago Brand.....	2847	3100	Orleans	Found.....	1.7	2.2	8.6	3.6	.....
Darling's Chicago Brand.....	2847	3101	Ellettsville ..	Found.....	1.6	2.4	8.9	3.5	.....
Darling's Vegetable and Lawn Fertilizer.	2848	.....	.....	Guaranteed	3.3	7.0	8.0	.....	.....
Darling's Vegetable and Lawn Fertilizer.	2848	3102	Bedford	Found.....	3.3	7.7	7.8	2.6	.....
Darling's Farmer's Favorite Brand.....	2849	.....	.....	Guaranteed	2.4	4.0	8.0	.....	.....
Darling's Farmer's Favorite Brand.....	2849	3103	Osgood	Found.....	2.4	4.3	7.4	5.5	.....
Darling's Farmer's Favorite Brand.....	2849	3104	Pierceville ..	Found.....	2.5	4.0	8.1	4.9	.....
Darling's Farmer's Favorite Brand.....	2849	3105	Dale	Found.....	2.3	4.3	8.2	4.0	.....
Sure Winner Brand.....	3280	.....	.....	Guaranteed	0.8	3.0	8.0	.....	.....
Sure Winner Brand.....	3280	3106	Osgood	Found.....	1.0	3.3	7.7	1.7	.....
Sure Winner Brand.....	3280	3107	Brookville ..	Found.....	1.0	3.2	8.6	1.8	.....
Pure Ground Bone.....	3281	.....	.....	Guaranteed	2.4	.....	.....	.....	23.0
Pure Ground Bone.....	3281	3108	Ellettsville ..	Found.....	2.7	.....	.....	.....	26.6
Pure Ground Bone.....	3281	3109	Osgood	Found.....	3.1	.....	.....	.....	25.6
Sulphate of Potash.....	3504	.....	.....	Guaranteed	....	48.0	.....	.....	.....
Sulphate of Potash.....	3504	3110	Orleans	Found.....	....	49.3	.....	.....	.....
D. & K. Fertilizer Co., Indianapolis, Ind.									
Wheat Fertilizer.....	3027	.....	.....	Guaranteed	1.7	1.5	8.0	2.2	.....
Wheat Fertilizer.....	3027	3111	Connersville	Found.....	0.7	1.3	9.4	3.2	.....
Dissolved Bone with Potash.....	3362	.....	.....	Guaranteed	0.8	1.1	7.0	1.0	.....
Dissolved Bone with Potash.....	3362	3112	Osgood	Found.....	0.7	1.1	10.0	6.4	.....
Dissolved Bone with Potash.....	3362	3113	Boonville	Found.....	0.9	1.5	7.7	5.0	.....
Dissolved Bone with Potash.....	3362	3114	Connersville .	Found.....	0.7	1.2	9.2	3.4	.....
Pure Ground Bone	3363	.....	.....	Guaranteed	1.6	.....	.....	.....	20.0
Pure Ground Bone	3363	3115	Connersville .	Found.....	2.0	.....	.....	.....	21.7
Quick Acting Corn Grower.....	3402	.....	.....	Guaranteed	0.8	1.5	9.0	0.5	.....
Quick Acting Corn Grower.....	3402	3116	Blocher	Found.....	0.8	0.9	10.3	6.0	.....
Empire Carbon Works, National Stock Yards, Ills.									
Empire Raw Bone Meal.....	2986	.....	.....	Guaranteed	3.2	.....	.....	.....	22.0
Empire Raw Bone Meal.....	2986	3117	Bloomington	Found.....	3.6	.....	.....	.....	20.1
Empire Guano Co., The, Nashville, Tenn.									
Empire High Grade Acid Phosphate....	3307	.....	.....	Guaranteed	....	.....	14.0	2.0	.....
Empire High Grade Acid Phosphate....	3307	3118	Paoli	Found.....	....	.....	13.2	2.4	.....

Report of Inspections—Continued.

LABEL	Number: Official	Number: Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Empire Guano Co., The, Nashville, Tenn.									
Empire High Grade Acid Phosphate	3307	3119	Salem	Found	....	.....	13.6	2.9	.....
Empire Bone and Potash	3309	.....	.....	Guaranteed	....	2.0	10.0	2.0	.....
Empire Bone and Potash	3309	3120	Corydon	Found	....	1.8	10.1	1.2	.....
Empire Bone and Potash	3309	3121	Brcokville	Found	....	2.0	10.7	2.1	.....
Empire Potash Mixture	3507	.....	.....	Guaranteed	....	4.0	10.0	2.0	.....
Empire Potash Mixture	3507	3122	Eckerty	Found	....	4.4	8.3	6.4	.....
Empire Climax Acid Phosphate	3514	.....	.....	Guaranteed	....	.....	16.0	1.0	.....
Empire Climax Acid Phosphate	3514	3123	Corydon	Found	....	.....	13.9	2.1	.....
Ewing, Geo. M., Greensburg, Ind.									
Ewing's Phosphate and Potash	3324	.....	.....	Guaranteed	....	2.0	10.0	.....	.....
Ewing's Phosphate and Potash	3324	3124	Greensburg	Found	....	3.0	10.7	0.6	.....
Ewing's Phosphate and Potash	3324	3125	Burney	Found	....	2.2	10.3	1.3	.....
Ewing's Best Phosphate and Potash	3325	.....	.....	Guaranteed	....	2.0	12.0	.....	.....
Ewing's Best Phosphate and Potash	3325	3126	Greensburg	Found	....	2.7	13.1	0.1	.....
Ewing's Potash Mixture	3498	.....	.....	Guaranteed	....	4.0	10.0	2.0	.....
Ewing's Potash Mixture	3498	3127	Greensburg	Found	....	4.3	10.9	0.2	.....
Ewing's Complete Fertilizer	3619	.....	.....	Guaranteed	0.8	1.0	7.0	.....	.....
Ewing's Complete Fertilizer	3619	3128	Greensburg	Found	0.9	1.4	5.7	2.4	.....
Farmers Fertilizer Co., Indianapolis, Ind.									
Farmers Eureka Phosphate	3198	.....	.....	Guaranteed	....	.....	10.0	.....	.....
Farmers Eureka Phosphate	3198	3129	Holton	Found	....	.....	10.4	1.6	.....
Farmers Eureka Phosphate	3198	3130	Corydon Junc	Found	....	.....	11.1	1.2	.....
Farmers Wheat and Oats Special	3199	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Farmers Wheat and Oats Special	3199	3131	Eckerty	Found	....	.....	15.3	1.8	.....
Farmers Phosphate and Potash	3200	.....	.....	Guaranteed	....	2.0	10.0	.....	.....
Farmers Phosphate and Potash	3200	3132	Brookville	Found	....	2.0	9.4	3.2	.....
Farmers Half and Half	3204	.....	.....	Guaranteed	2.0	.....	8.5	6.0	.....
Farmers Half and Half	3204	3133	Eckerty	Found	1.9	.....	9.4	8.1	.....
Farmers Half and Half	3204	3134	Canaan	Found	2.0	.....	9.6	7.3	.....
Farmers Pure Bone Meal	3205	.....	.....	Guaranteed	2.4	.....	.....	.....	22.0
Farmers Pure Bone Meal	3205	3135	English	Found	2.3	.....	.....	.....	28.8
Farmers Pure Bone Meal	3205	3136	Eckerty	Found	2.5	.....	.....	.....	28.9
Farmers Pure Bone Meal	3205	3137	Osgood	Found	2.4	.....	.....	.....	28.6
Electric Guano	3315	.....	.....	Guaranteed	....	4.0	10.0	.....	.....
Electric Guano	3315	3138	LaFayette	Found	....	3.0	11.2	1.5	.....
Electric Guano	3315	3139	Corydon Junc	Found	....	3.4	11.1	0.7	.....
Farmers Harvest King	3393	.....	.....	Guaranteed	1.1	5.0	8.5	2.5	.....
Farmers Harvest King	3393	3140	Brookville	Found	0.9	4.9	9.2	4.6	.....
Farmers Harvest King	3393	3141	Corydon Junc	Found	1.1	4.6	10.1	3.2	.....
Our Universal Phosphate	3555	.....	.....	Guaranteed	0.8	1.0	7.0	1.0	.....
Our Universal Phosphate	3555	3142	Eckerty	Found	0.7	1.0	8.1	3.5	.....
Our Universal Phosphate	3555	3143	Corydon Junc	Found	0.5	1.5	10.3	1.8	.....
Corn and Wheat Grower	3556	.....	.....	Guaranteed	0.8	2.0	8.0	1.0	.....
Corn and Wheat Grower	3556	3144	Orleans	Found	0.7	1.8	10.0	4.3	.....
Corn and Wheat Grower	3556	3145	Eckerty	Found	0.9	2.4	8.8	3.2	.....
Our German Phosphate	3557	.....	.....	Guaranteed	0.8	3.0	8.0	1.0	.....
Our German Phosphate	3557	3146	Orleans	Found	0.6	1.7	10.7	4.4	.....
Our German Phosphate	3557	3147	Eckerty	Found	0.9	3.7	8.7	3.4	.....
Fox Chemical Co., Louisville, Ky.									
Fox Wheat and Corn Grower	2729	.....	.....	Guaranteed	1.6	2.0	10.0	.....	.....
Fox Wheat and Corn Grower	2729	3148	Mitchell	Found	1.5	2.3	11.1	0.5	.....
Fox Wheat and Corn Grower	2729	3149	Indian Springs	Found	1.7	2.0	11.5	1.1	.....
Fox Alkaline Bone	2731	.....	.....	Guaranteed	....	2.0	10.0	.....	.....
Fox Alkaline Bone	2731	3150	Paoli	Found	....	1.8	11.7	0.8	.....
Fox Alkaline Bone	2731	3151	French Lick	Found	....	1.8	9.0	0.7	.....
Fox Acid Phosphate	2732	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Fox Acid Phosphate	2732	3152	Paoli	Found	....	.....	14.2	1.4	.....
Fox Acid Phosphate	2732	3153	French Lick	Found	....	.....	12.1	0.8	.....
A. A. Acid Phosphate	2733	.....	.....	Guaranteed	....	.....	10.0	.....	.....
A. A. Acid Phosphate	2733	3154	Paoli	Found	....	.....	12.7	1.0	.....
A. A. Acid Phosphate	2733	3155	French Lick	Found	....	.....	11.1	0.6	.....
Fox Bone and Potash	2734	.....	.....	Guaranteed	....	1.0	9.0	.....	.....
Fox Bone and Potash	2734	3156	Alton	Found	....	1.2	8.5	0.8	.....
Fox Grain Special	3111	.....	.....	Guaranteed	0.4	1.5	9.0	1.0	.....
Fox Grain Special	3111	3157	Paoli	Found	0.5	1.6	9.0	1.1	.....
Fox Grain Specia	3111	3158	Indian Springs	Found	0.4	1.5	9.2	0.5	.....

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Fox Chemical Co., Branch Federal Chemical Co., Louisville, Ky.									
Fox Raw Bone	3345	.....	.....	Guaranteed	3.2	.....	.....	.....	20.0
Fox Raw Bone	3345	3159	Heltonville ..	Found	3.2	.....	.....	.....	22.8
Fox Formula	3370	.....	.....	Guaranteed	0.7	3.5	11.0	.....	.....
Fox Formula	3370	3160	Indian Springs	Found	0.8	2.6	12.3	0.5	.....
Fox Bone Phosphate and Potash	3494	.....	.....	Guaranteed	....	4.0	10.0	.....	.....
Fox Bone Phosphate and Potash	3494	3161	Paoli	Found	....	3.8	10.5	0.8	.....
Fox Bone Phosphate and Potash	3494	3162	Osgood	Found	....	4.1	9.4	0.6	.....
Fox Bone, Blood and Potash	3573	.....	.....	Guaranteed	0.3	1.0	11.0	2.0	.....
Fox Bone, Blood and Potash	3573	3163	Paoli	Found	0.5	1.3	11.2	1.0	.....
Fox Bone, Blood and Potash	3573	3164	Morgantown	Found	0.5	1.0	11.1	0.4	.....
Fox Wheat and Grain Special	3575	.....	.....	Guaranteed	0.8	1.0	12.0	2.0	.....
Fox Wheat and Grain Special	3575	3165	Heltonville ..	Found	0.8	1.2	12.5	0.6	.....
Globe Fertilizer Co., Louisville, Ky.									
Acorn Acid Phosphate	2719	.....	.....	Guaranteed	....	.....	10.0	.....	.....
Acorn Acid Phosphate	2719	3166	Corydon	Found	....	.....	8.8	2.3	.....
Acorn Acid Phosphate	2719	3167	Corydon	Found	....	.....	10.5	0.9	.....
Globe Acid Phosphate	2720	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Globe Acid Phosphate	2720	3168	Jasper	Found	....	.....	13.7	1.6	.....
Globe Acid Phosphate	2720	3169	Peoria	Found	....	.....	14.1	0.4	.....
Globe Acid Phosphate	2720	3170	Morgantown	Found	....	.....	14.1	0.7	.....
Big 4 Phosphate	2721	.....	.....	Guaranteed	....	1.0	8.0	.....	.....
Big 4 Phosphate	2721	3171	Corydon	Found	....	0.6	8.8	0.6	.....
Big 4 Phosphate	2721	3172	Depauw	Found	....	1.0	8.2	0.6	.....
Globe Bone Dust	2723	.....	.....	Guaranteed	0.8	1.0	9.0	.....	.....
Globe Bone Dust	2723	3173	Jasper	Found	0.9	1.5	9.2	2.2	.....
Globe Bone Dust	2723	3174	Centerville ..	Found	1.2	1.1	10.5	1.2	.....
Globe Bone and Potash	2724	.....	.....	Guaranteed	0.3	1.0	11.0	.....	.....
Globe Bone and Potash	2724	3175	Corydon Junc	Found	0.5	1.1	10.6	2.0	.....
Globe Bone and Potash	2724	3176	Centerville ..	Found	0.5	1.2	11.5	0.5	.....
Globe Bone and Potash	2724	3177	Morgantown	Found	0.5	1.2	11.1	0.6	.....
Globe Wheat Grower	2725	.....	.....	Guaranteed	1.6	2.0	10.0	.....	.....
Globe Wheat Grower	2725	3178	Morgantown	Found	1.6	2.0	10.0	2.1	.....
Progress Wheat and Corn Grower	2726	.....	.....	Guaranteed	1.6	1.0	9.0	.....	.....
Progress Wheat and Corn Grower	2726	3179	Corydon Junc	Found	1.5	1.2	10.4	1.1	.....
Progress Wheat and Corn Grower	2726	3180	New Albany..	Found	1.6	1.1	10.2	1.4	.....
Progress Wheat and Corn Grower	2726	3181	Centerville ..	Found	1.8	1.1	10.2	1.4	.....
Eagle Corn and Wheat Grower	2727	.....	.....	Guaranteed	1.6	2.0	8.0	.....	.....
Eagle Corn and Wheat Grower	2727	3182	Corydon	Found	1.4	2.0	9.9	1.6	.....
Eagle Corn and Wheat Grower	2727	3183	Morgantown	Found	1.5	2.1	8.5	1.6	.....
Globe Grain Grower	3109	.....	.....	Guaranteed	0.4	1.5	9.0	1.0	.....
Globe Grain Grower	3109	3184	Tell City....	Found	0.5	1.8	8.0	1.2	.....
Globe Grain Grower	3109	3185	Spencer	Found	0.8	1.1	10.7	0.7	.....
Acorn Bone Meal	3110	.....	.....	Guaranteed	2.4	.....	.....	.....	22.7
Acorn Bone Meal	3110	3186	Corydon	Found	2.8	.....	.....	.....	26.8
Globe Bone Meal	3168	.....	.....	Guaranteed	3.2	.....	.....	.....	20.0
Globe Bone Meal	3168	3187	Lawrenceb'rg	Found	3.5	.....	.....	.....	18.5
Globe Bone Meal	3168	3188	Depauw	Found	3.8	.....	.....	.....	20.8
Golden Harvest Bone Meal	3173	.....	.....	Guaranteed	2.4	.....	10.0	1.0	.....
Golden Harvest Bone Meal	3173	3189	Magnet	Found	2.2	.....	12.1	4.0	.....
Globe Fertilizer Co., Branch Federal Chemical Co., Louisville, Ky.									
Potash Special	3366	.....	.....	Guaranteed	....	2.0	10.0	.....	.....
Potash Special	3366	3190	Corydon Junc	Found	....	1.7	9.5	0.6	.....
Potash Special	3366	3191	Morgantown	Found	....	1.8	10.2	0.5	.....
Braden Formula	3369	.....	.....	Guaranteed	0.7	3.5	11.0	.....	.....
Braden Formula	3369	3192	Milford	Found	0.7	2.3	11.2	1.3	.....
Braden Formula	3369	3193	Martinsville .	Found	0.8	2.4	12.0	0.9	.....
Globe Soluble Vegetable Manure	3497	.....	.....	Guaranteed	1.6	5.0	8.0	2.0	.....
Globe Soluble Vegetable Manure	3497	3194	Corydon	Found	1.5	5.2	8.9	0.9	.....
Globe Bone Phosphate and Potash	3577	.....	.....	Guaranteed	....	4.0	10.0	2.0	.....
Globe Bone Phosphate and Potash	3577	3195	Corydon	Found	....	3.1	8.9	0.8	.....
Globe Bone Phosphate and Potash	3577	3196	Borden	Found	....	3.4	10.1	1.0	.....
Wheat and Grain Special	3579	.....	.....	Guaranteed	0.8	1.0	12.0	2.0	.....
Wheat and Grain Special	3579	3197	Morgantown	Found	0.8	1.2	12.3	0.6	.....
Globe High Grade Acid Phosphate	3608	.....	.....	Guaranteed	....	.....	16.0	.....	.....
Globe High Grade Acid Phosphate	3608	3198	Liberty	Found	....	.....	16.1	0.2	.....

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Hardy Packing Co., The Chicago, Ills.									
Hardy's Tobacco and Potato Special....	3219	.....	.....	Guaranteed	1.6	4.0	8.0	1.0	.....
Hardy's Tobbacco and Potato Special....	3219	3199	Marysville ...	Found.....	1.7	3.5	8.8	0.8	.....
Hardy's Corn and Wheat Grower.....	3221	.....	.....	Guaranteed	0.4	2.5	8.0	1.0	.....
Hardy's Corn and Wheat Grower.....	3221	3200	Campbellsburg	Found.....	0.3	2.2	7.9	2.0	.....
Hardy's Corn and Wheat Grower.....	3221	3201	Vevay	Found.....	0.4	3.3	8.5	1.4	.....
Hardy's No. 1 Crop Producer.....	3222	.....	.....	Guaranteed	0.8	1.0	7.0	1.0	.....
Hardy's No. 1 Crop Producer.....	3222	3202	Knightstown	Found.....	0.4	0.8	7.1	2.8	.....
Hess & Bro., S. M., Philadelphia, Pa.									
Keystone Bone Phosphate	2991	.....	.....	Guaranteed	0.8	1.0	8.0	2.0	.....
Keystone Bone Phosphate.....	2991	3203	Schnellville ..	Found.....	0.9	1.1	7.3	1.6	.....
Keystone Bone Phosphate.....	2991	3204	Milroy	Found.....	1.0	1.0	8.1	3.2	.....
Wheat and Grass Manure.....	2993	.....	.....	Guaranteed	0.8	2.0	8.0	1.0	.....
Wheat and Grass Manure.....	2993	3205	Brookville ...	Found.....	1.0	2.1	8.0	3.1	.....
Ammoniated Bone Superphosphate.....	3170	.....	.....	Guaranteed	1.6	2.0	8.0	1.0	.....
Ammoniated Bone Superphosphate.....	3170	3206	Brookville ...	Found.....	1.7	2.0	7.9	2.5	.....
Acid Phosphate	3535	.....	.....	Guaranteed	....	.....	12.0	2.0	.....
Acid Phosphate	3535	3207	Schnellville .	Found.....	....	.....	12.6	2.3	.....
Hopkins & Co., A New Albany, Ind.									
Hopkins Old Times Bone and Potash..	3133	.....	.....	Guaranteed	0.8	2.1	5.6	0.5	.....
Hopkins Old Times Bone and Potash....	3133	3208	Corydon	Found.....	0.6	1.8	4.7	2.1	.....
Hopkins Old Times Bone and Potash....	3133	3209	New Albany..	Found.....	0.4	1.4	5.3	2.9	.....
Hopkins Fertilizer Co., New Albany, Ind.									
Muriate of Potash.....	3330	.....	.....	Guaranteed	....	50.0	.....	.....	.....
Muriate of Potash	3330	3210	Corydon	Found.....	....	47.2	.....	.....	.....
Hopkins "Old Times Special Crop Grower"	3374	.....	.....	Guaranteed	1.0	6.0	8.5	.....	.....
Hopkins "Old Times Special Crop Grower"	3374	3211	New Albany..	Found.....	0.9	5.5	7.3	3.4	.....
Hopkins "Old Times Special Crop Grower"	3374	3212	New Albany..	Found.....	1.0	4.5	6.6	3.3	.....
Hopkins "Old Times Bone Meal".....	3428	.....	.....	Guaranteed	3.0	.....	.....	.....	17.0
Hopkins "Old Times Bone Meal".....	3428	3213	Marysville ...	Found.....	3.1	.....	.....	.....	15.9
Hopkins "Old Times Wheat and Corn Grower"	3429	.....	.....	Guaranteed	1.0	2.0	8.5	.....	.....
Hopkins "Old Times Wheat and Corn Grower"	3429	3214	New Albany..	Found.....	0.7	1.9	6.6	3.1	.....
Hopkins "Old Times Wheat and Corn Grower"	3429	3215	New Albany..	Found.....	1.1	2.1	6.7	4.1	.....
Hopkins "Old Times Pure Raw Bone"..	3430	.....	.....	Guaranteed	3.5	.....	.....	.....	21.5
Hopkins "Old Time Pure Raw Bone"..	3430	3216	New Albany..	Found.....	3.7	.....	.....	.....	21.0
Hopkins "Old Times Pure Raw Bone"..	3430	3217	Campbellsburg	Found.....	3.6	.....	.....	.....	20.6
Hopkins "Old Times Half and Half"..	3433	.....	.....	Guaranteed	2.0	2.0	6.0	6.0	.....
Hopkins "Old Times Half and Half"..	3433	3219	New Albany..	Found.....	2.0	2.1	4.5	7.2	.....
Hopkins "Old Times Half and Half"..	3433	3220	Salem	Found.....	2.0	1.8	4.7	7.1	.....
Hopkins "Old Times Fine Ground Bone"	3664	.....	.....	Guaranteed	2.0	.....	.....	.....	28.0
Hopkins "Old Times Fine Ground Bone"	3664	3221	Corydon	Found.....	2.0	.....	.....	.....	27.1
Hubbell & Son Fertilizer Co., L. W., Francesville, Ind.									
Hubbell's Corn and Clover Grower.....	3627	.....	.....	Guaranteed	....	4.0	10.0	.....	.....
Hubbell's Corn and Clover Grower.....	3627	3222	Francesville ..	Found.....	....	4.3	11.3	0.4	.....
Hubbell's Special Corn Grower.....	3628	.....	.....	Guaranteed	....	6.0	8.0	.....	.....
Hubbell's Special Corn Grower.....	3628	3223	Wolcott	Found.....	....	6.6	9.9	0.5	.....
Kainit	3641	.....	.....	Guaranteed	....	12.0	.....	.....	.....
Kainit	3641	3224	Francesville ..	Found.....	....	12.6	.....	.....	.....
Muriate of Potash.....	3642	.....	.....	Guaranteed	....	50.0	.....	.....	.....
Muriate of Potash.....	3642	3225	Francesville ..	Found.....	....	47.6	.....	.....	.....
Indianapolis Fertilizer Co., Indianapolis, Ind.									
Bone and Blood with Potash.....	3395	.....	.....	Guaranteed	1.1	0.8	7.0	0.7	.....
Bone and Blood with Potash.....	3395	3226	Batesville	Found.....	0.4	0.8	9.7	4.7	.....
Indianapolis Rendering Co., Indianapolis, Ind.									
Banner Bone.....	3258	.....	.....	Guaranteed	2.4	.....	.....	.....	25.0
Banner Bone.....	3258	3227	Sunman	Found.....	2.1	.....	.....	.....	28.8
Banner Bone.....	3258	3228	Salem	Found.....	1.7	.....	.....	.....	29.9

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Indianapolis Rendering Co., Indianapolis, Ind.									
Half and Half	3259	.....	.....	Guaranteed	2.0	.....	8.0	6.0	.....
Half and Half	3259	3229	Corydon	Found.....	1.6	.....	9.6	6.1	.....
Half and Half	3259	3230	Sunman	Found.....	1.9	.....	9.2	6.9	.....
Phosphate and Potash	3263	.....	.....	Guaranteed	....	2.0	10.0	.....	.....
Phosphate and Potash	3263	3231	Norris	Found.....	....	1.7	10.3	2.5	.....
Phosphate and Potash	3263	3232	Corydon	Found.....	....	1.5	11.4	1.4	.....
Super Phosphate	3264	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Super Phosphate	3264	3233	Salem	Found.....	....	.....	13.8	1.8	.....
Union Phosphate	3265	.....	.....	Guaranteed	....	.....	10.0	.....	.....
Union Phosphate	3265	3234	Leipsic	Found.....	....	.....	8.3	2.7	.....
Potash Special	3361	.....	.....	Guaranteed	....	4.0	10.0	.....	.....
Potash Special	3361	3235	Corydon	Found.....	....	1.4	11.1	0.6	.....
Our Grain Grower	3561	.....	.....	Guaranteed	0.8	1.0	7.0	1.0	.....
Our Grain Grower	3561	3236	Norris	Found.....	0.7	1.3	8.9	3.9	.....
Our Grain Grower	3561	3237	Salem	Found.....	1.2	3.2	8.5	4.4	.....
Our Grain Grower	3561	3238	Delaware	Found.....	0.8	1.2	7.6	2.8	.....
Corn and Wheat Grower	3562	.....	.....	Guaranteed	0.8	2.0	8.0	1.0	.....
Corn and Wheat Grower	3562	3239	Norris	Found.....	0.7	1.9	9.2	2.9	.....
Corn and Wheat Grower	3562	3240	Salem	Found.....	1.0	1.8	10.1	3.0	.....
Our Bone and Potash	3563	.....	.....	Guaranteed	0.8	3.0	8.0	1.0	.....
Our Bone and Potash	3563	3241	Norris	Found.....	0.7	2.6	9.5	2.9	.....
Our Bone and Potash	3563	3242	Corydon	Found.....	0.6	2.6	10.6	2.0	.....
Jarecki Chemical Co., The, Sandusky, Ohio.									
Dissolved Bone with Potash	2913	.....	.....	Guaranteed	....	3.0	12.0	1.0	.....
Dissolved Bone with Potash	2913	3243	Orleans	Found.....	....	2.0	12.7	2.2	.....
Dissolved Bone with Potash	2913	3244	Franklin	Found.....	....	2.3	11.6	2.9	.....
O. K. Fertilizer	2915	.....	.....	Guaranteed	0.4	0.5	5.0	1.0	.....
O. K. Fertilizer	2915	3245	St. Paul	Found.....	0.7	1.0	5.9	1.9	.....
Dissolved Bone Black Wheat Special	2916	.....	.....	Guaranteed	....	.....	15.0	1.0	.....
Dissolved Bone Black Wheat Special	2916	3246	Mineral City.	Found.....	....	.....	15.4	1.5	.....
St. Bernard Phosphate	2917	.....	.....	Guaranteed	....	.....	12.0	1.0	.....
St. Bernard Phosphate	2917	3247	Mineral City.	Found.....	....	.....	12.0	3.1	.....
C. O. D. Phosphate	2918	.....	.....	Guaranteed	....	.....	14.0	1.0	.....
C. O. D. Phosphate	2918	3248	St. Anthony..	Found.....	....	.....	14.6	2.0	.....
Fish and Potash Grain Special	2919	.....	.....	Guaranteed	1.2	2.0	9.0	1.0	.....
Fish and Potash Grain Special	2919	3249	Mineral City.	Found.....	1.3	2.2	7.7	3.3	.....
No. One, Fish Guano	2920	.....	.....	Guaranteed	0.8	1.0	10.0	1.0	.....
No. One, Fish Guano	2920	3250	Blocher	Found.....	1.0	1.4	9.7	2.4	.....
No. One, Fish Guano	2920	3251	Mineral City.	Found.....	0.8	1.0	9.7	2.6	.....
Square Brand Phosphate and Potash	3458	.....	.....	Guaranteed	....	2.0	10.0	1.0	.....
Square Brand Phosphate and Potash	3458	3252	Blocher	Found.....	....	1.7	8.9	3.2	.....
Square Brand Phosphate and Potash	3458	3253	Franklin	Found.....	....	2.4	9.5	3.5	.....
Lake Erie Guano	3475	.....	.....	Guaranteed	0.8	2.0	10.0	1.0	.....
Lake Erie Guano	3475	3254	Sunman	Found.....	0.6	1.9	9.9	2.1	.....
Lake Erie Guano	3475	3255	Franklin	Found.....	1.0	2.2	7.5	3.2	.....
Johnson D. B., Mooresville, Ind.									
D. B. Johnson's Dissolved Bone Phosphate	3350	.....	.....	Guaranteed	....	.....	14.0	.....	.....
D. B. Johnson's Dissolved Bone Phosphate	3350	3256	Valparaiso ..	Found.....	....	.....	11.2	3.7	.....
D. B. Johnson's Dissolved Bone Phosphate	3350	3257	Mooresville ..	Found.....	....	.....	14.4	1.2	.....
Jones Fertilizing Co., The Cincinnati, Ohio.									
"Jones" Miami Valley Phosphate	3289	.....	.....	Guaranteed	1.6	2.0	10.0	2.0	.....
"Jones" Miami Valley Phosphate	3289	3258	Vevay	Found.....	1.6	2.0	9.6	1.5	.....
High Grade Dissolved Bone	3347	.....	.....	Guaranteed	....	.....	14.0	1.0	.....
High Grade Dissolved Bone	3347	3259	Brookville ...	Found.....	....	.....	14.4	1.2	.....
High Grade Dissolved Bone	3347	3260	Marengo	Found.....	....	.....	13.0	1.4	.....
Potash Mixture	3348	.....	.....	Guaranteed	....	2.0	10.0	1.0	.....
Potash Mixture	3348	3261	Brookville ...	Found.....	....	1.7	11.0	2.3	.....
Jones Fertilizing Co., The Louisvile, Ky									
Jones Corn and Wheat Grower	3565	.....	.....	Guaranteed	0.8	1.0	7.0	1.0	.....
Jones Corn and Wheat Grower	3565	3262	Brookville ...	Found.....	1.0	0.9	6.8	2.7	.....
Jones Corn and Wheat Grower	3565	3263	Millhausen ..	Found.....	1.1	1.4	8.5	1.7	.....
Jones Corn and Wheat Grower	3565	3264	Marengo	Found.....	1.3	1.0	7.6	1.9	.....
Indiana Jones Reliable	3567	.....	.....	Guaranteed	0.8	1.5	8.0	1.0	.....
Indiana Jones Reliable	3567	3265	Brookville ...	Found.....	1.1	1.3	9.0	2.9	.....

Report of Inspections—Continued.

LABEL	Number		Sample Taken at		Nitrogen per cent.	Potash sol. In water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
	Official	Inspection B							
J. B. Jones, Louisville, Ky.									
Jones Wheat Grower	3654			Guaranteed	1.7	2.0	9.0	2.0	
Jones Wheat Grower	3654	3266	Watson	Found	1.7	1.6	6.2	2.7	
Jones Robin, Nashville, Tenn.									
Ground Phosphate Rock	3551			Guaranteed					28.0
Ground Phosphate Rock	3551	3267	Paoli	Found					30.6
Kaufman Fertilizer Co., Indianapolis, Ind.									
Pure Bone	3068			Guaranteed	2.2				25.5
Pure Bone	3068	3268	Marengo	Found	3.1				25.3
Half and Half	3070			Guaranteed	1.7		9.2	3.5	
Half and Half	3070	3269	Shoals	Found	0.5		8.2	1.1	
Half and Half	3070	3270	Brookville	Found	0.6		7.2	0.8	
Special Wheat Fertilizer	3071			Guaranteed	1.6	2.0	8.7	1.2	
Special Wheat Fertilizer	3071	3271	Shoals	Found	0.3	0.4	8.3	1.1	
Special Wheat Fertilizer	3071	3272	Brookville	Found	0.5	0.1	8.8	0.8	
Banner Crop Grower	3073			Guaranteed	0.8	1.0	7.0		
Banner Crop Grower	3073	3273	Leipsic	Found	0.8	0.9	7.1	1.5	
Banner Crop Grower	3273	3274	Bloomington	Found	0.3	0.3	7.8	1.6	
Alkaline Bone and Potash	3074			Guaranteed		2.0	10.0		
Alkaline Bone and Potash	3074	3275	Brookville	Found		0.4	8.7	1.1	
Corn Fertilizer	3255			Guaranteed	1.0	2.0	8.0		
Corn Fertilizer	3255	3276	Leipsic	Found	0.8	1.8	7.1	1.6	
Harvest King	3256			Guaranteed	1.0	2.0	8.0		
Harvest King	3256	3277	Leipsic	Found	0.9	2.3	7.3	1.6	
Harvest King	3256	3278	Shoals	Found	0.4	0.5	8.5	1.3	
Harvest King	3256	3279	Bloomington	Found	0.6	0.4	6.7	0.9	
Tobacco and Potato Fertilizer	3257			Guaranteed	2.0	4.0	9.0	1.0	
Tobacco and Potato Fertilizer	3257	3280	New Albany	Found	1.8	3.2	8.8	1.6	
Pure Acid Phosphate	3438			Guaranteed			16.0		
Pure Acid Phosphate	3438	3281	New Albany	Found			15.1	1.3	
Wheat Fertilizer	3532			Guaranteed	1.0	2.0	8.0		
Wheat Fertilizer	3532	3282	Trafalgar	Found	0.4	0.4	9.2	1.5	
Kaufman I. X. L. Phosphate	3645			Guaranteed			14.0		
Kaufman I. X. L. Phosphate	3645	3283	Brookville	Found			10.6	1.1	
Lister Joseph, Chicago, Ills.									
Pure Bone Meal	3141			Guaranteed	2.5				25.0
Pure Bone Meal	3141	3284	Bloomington	Found	2.4				26.3
Louisville Fertilizer Co., Louisville, Ky.									
Bone Meal	2785			Guaranteed	0.8		3.0	17.0	
Bone Meal	2785	3285	Batesville	Found	1.2		7.0	12.5	
Bone Meal	2785	3286	Columbus	Found	1.2		7.2	12.0	
Special Wheat Grower	2786			Guaranteed	0.8	1.0	7.0	1.0	
Special Wheat Grower	2786	3287	Manchester	Found	0.8	0.9	6.4	3.3	
Special Wheat Grower	2786	3288	Farabee	Found	0.8	1.0	7.9	0.7	
Soluble Bone	2788			Guaranteed	0.8	1.5	8.0	1.0	
Soluble Bone	2788	3289	Vevay	Found	0.7	1.3	8.4	0.6	
Soluble Bone	2788	3290	Farabee	Found	0.8	1.3	8.4	0.4	
Corn and Wheat Grower	2789			Guaranteed	0.1	0.5	10.0	1.0	
Corn and Wheat Grower	2789	3291	Batesville	Found	0.2	0.4	10.0	0.5	
Corn and Wheat Grower	2789	3292	Columbus	Found	0.2	0.3	9.5	0.8	
Eagle Indiana High Grade Dissolved Bone	3340			Guaranteed			14.0	1.0	
Eagle Indiana High Grade Dissolved Bone	3340	3293	Manchester	Found			13.1	1.2	
Eagle Indiana Potash Mixture	3341			Guaranteed		2.0	10.0	1.0	
Eagle Indiana Potash Mixture	3341	3294	Columbus	Found		1.7	10.8	0.5	
Eagle Indiana Potash Mixture	3341	3295	Batesville	Found		1.8	10.3	0.6	
Eagle Guano	3423			Guaranteed	1.6	2.0	10.0	1.0	
Eagle Guano	3423	3296	Columbus	Found	1.5	2.0	10.2	1.7	
XX Ground Bone	3523			Guaranteed	1.2		4.0	11.0	
XX Ground Bone	3523	3297	Vevay	Found	1.3		9.1	10.7	
Eagle Indiana Phosphate	3564			Guaranteed			12.0	1.0	
Eagle Indiana Phosphate	3564	3298	Farabee	Found			10.7	1.8	
Madison Fertilizer and Glue Works, Madison, Ind.									
Valley City Corn Grower	2929			Guaranteed	2.0	1.0	8.0	3.5	
Valley City Corn Grower	2929	3299	Madison	Found	1.2	1.8	7.7	7.6	
Valley City Wheat Grower	3151			Guaranteed	2.0	1.0	8.0	3.5	
Valley City Wheat Grower	3151	3300	Madison	Found	1.1	1.0	6.9	6.4	

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Mathiason Mfg. Co., P. B., St. Louis, Mo.									
Increscent Brand Raw Bone Meal	3046			Guaranteed	3.2				20.0
Increscent Brand Raw Bone Meal	3046	3301	Taswell	Found	3.3				20.6
Increscent Brand Acidulated Bone and Potash	3051			Guaranteed	2.2	2.0	8.0	2.0	
Increscent Brand Acidulated Bone and Potash	3051	3302	Taswell	Found	2.3	2.0	6.2	6.5	
Mayer M'f'g. Co., A. B. St. Louis, Mo.									
Anchor Brand Pure Bone Meal	2779			Guaranteed	3.0				20.0
Anchor Brand Pure Bone Meal	2779	3303	Tell City	Found	3.4				24.1
Anchor Brand Pure Bone Meal	2779	3304	St. Anthony	Found	3.1				20.5
Anchor Brand St. Louis Bone Meal	2780			Guaranteed	2.5				16.0
Anchor Brand St. Louis Bone Meal	2780	3305	St. Anthony	Found	2.2				22.1
Anchor Brand Corn and Wheat Grower	2783			Guaranteed	2.5	2.0	6.0	4.0	
Anchor Brand Corn and Wheat Grower	2783	3306	St. Anthony	Found	2.0	1.7	7.8	6.0	
Mendenhall & Spillman, Greensburg, Ind.									
M. & S. Decatur County Special	3662			Guaranteed		4.0	10.0		
M. & S. Decatur County Special	3662	3307	Adams	Found		3.7	10.1	0.2	
Mertz, Thomas, Richmond, Ind.									
Common Sense Bone Meal	2937			Guaranteed	2.5				8.5
Common Sense Bone Meal	2937	3308	Richmond	Found	2.7				10.0
Michigan Carbon Works, Detroit, Mich.									
Desiccated Bone	2895			Guaranteed	1.2				25.0
Desiccated Bone	2895	3309	Bloomington	Found	1.3				32.9
Homestead A. B. B. Fertilizer	2896			Guaranteed	2.0	1.5	8.0		
Homestead A. B. B. Fertilizer	2896	3310	New Albany	Found	2.4	1.1	10.0	0.5	
Homestead A. B. B. Fertilizer	2896	3311	Morgantown	Found	2.0	1.7	8.0	4.2	
Homestead A. B. B. Fertilizer	2896	3312	Scottsburg	Found	2.4	1.9	10.2	0.3	
Red Line Complete Manure	2898			Guaranteed	0.8	1.0	7.0		
Red Line Complete Manure	2898	3313	North Vernon	Found	1.0	1.1	7.1	2.2	
Red Line Complete Manure	2898	3314	Bloomington	Found	1.0	1.2	6.8	1.5	
Red Line Crop Grower	2899			Guaranteed	1.6	2.0	8.0		
Red Line Crow Grower	2899	3315	Georgetown	Found	1.8	2.3	7.3	2.2	
Red Line Phosphate	2900			Guaranteed			14.0		
Red Line Phosphate	2900	3316	Marengo	Found			14.3	1.4	
Red Line Phosphate	2900	3317	Bloomington	Found			14.6	2.0	
Wolverine Phosphate	2901			Guaranteed			10.0		
Wolverine Phosphate	2901	3318	Tell City	Found			9.8	1.8	
Red Line Phosphate with Potash	2902			Guaranteed		2.0	10.0		
Red Line Phosphate with Potash	2902	3319	North Vernon	Found		1.7	8.8	3.6	
Red Line Phosphate with Potash	2902	3320	English	Found		1.6	8.5	3.4	
Wolverine Pure Ground Bone	3448			Guaranteed	2.4				20.0
Wolverine Pure Ground Bone	2448	3321	Vienna	Found	3.2				29.3
Wolverine Pure Ground Bone	3448	3322	Huntingburg	Found	3.2				27.3
Homestead Potato and Tobacco Special	3602			Guaranteed	2.0	5.0	8.0	1.0	
Homestead Potato and Tobacco Special	3602	3323	New Albany	Found	2.1	4.2	8.8	0.7	
Morris & Co., Nelson, Chicago, Ills.									
Big One	3021			Guaranteed	3.2				24.0
Big One	3021	3324	Seymour	Found	2.8				27.4
Big Two	3022			Guaranteed	2.0				28.0
Big Two	3022	3325	Salem	Found	2.7				26.8
Big Two	3022	3326	Seymour	Found	2.2				29.2
Big Three	3023			Guaranteed	2.5	2.0	4.0	6.0	
Big Three	3023	3327	Seymour	Found	2.5	1.8	4.2	4.9	
Big Four	3024			Guaranteed	4.1	4.0	5.0	5.0	
Big Four	3024	3328	Salem	Found	4.0	4.7	7.5	8.4	
Big Five	3025			Guaranteed	2.5	1.0	4.0	5.0	
Big Five	3025	3329	Salem	Found	3.2	1.7	6.6	5.2	
Big Five	3025	3330	Schnellville	Found	3.4	1.2	5.2	4.9	
Big Six Special Bone Meal	3303			Guaranteed	0.8				27.0
Big Six Special Bone Meal	3303	3331	Richmond	Found	1.2				27.4
Big Six Special Bone Meal	3303	3332	New Albany	Found	1.0				26.2
Big Six Special Bone Meal	3303	3333	Letts	Found	1.1				24.8
Big Seven High Grade Acid Phosphate	3304			Guaranteed			10.0	1.0	
Big Seven High Grade Acid Phosphate	3304	3334	Seymour	Found			12.9	0.2	
Big Seven High Grade Acid Phosphate	3304	3335	Schnellville	Found			10.7	3.7	

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Morris & Co., Nelson, Chicago, Ills.									
Big Eight Ammoniated Acid Phosphate with Potash	3305	.....	.....	Guaranteed	0.8	1.0	10.0	1.0	.....
Big Eight Ammoniated Acid Phosphate with Potash	3305	3336	Jasper	Found.....	1.0	1.4	10.3	3.5	.....
Big Eight Ammoniated Acid Phosphate with Potash	3305	3337	Jasper	Found.....	0.8	1.8	10.3	0.9	.....
1 McCallum & Co., Jas., Dayton, Ohio.									
Superior Pure Ground Bone	2828	.....	.....	Guaranteed	3.0	.....	.....	.....	23.0
Superior Pure Ground Bone	2828	3338	Crandall	Found.....	3.4	.....	.....	.....	21.8
Ruby Phosphate	2829	.....	.....	Guaranteed	0.5	1.0	12.0	1.0	.....
Ruby Phosphate	2829	3339	Shoals	Found.....	1.1	1.3	13.3	0.3	.....
Miami Phosphate	2830	.....	.....	Guaranteed	1.0	1.5	10.0	1.0	.....
Miami Phosphate	2830	3340	Union City..	Found.....	1.0	2.1	10.6	1.8	.....
Miami Phosphate	2830	3341	Crandall	Found.....	0.6	1.9	10.4	2.0	.....
Spot Cash Fertilizer	2831	.....	.....	Guaranteed	1.5	2.0	10.0	2.0	.....
Spot Cash Fertilizer	2831	3342	Shoals	Found.....	1.3	1.7	11.3	2.2	.....
Raw Bone and Phosphate	2834	.....	.....	Guaranteed	2.0	1.0	10.0	5.0	.....
Raw Bone and Phosphate	2834	3343	Leipsic	Found.....	1.2	1.4	10.3	7.7	.....
Raw Bone and Phosphate	2834	3344	Shoals	Found.....	1.3	1.5	10.9	4.2	.....
Onion and Truck Fertilizer	3468	.....	.....	Guaranteed	1.5	8.0	8.0	1.0	.....
Onion and Truck Fertilizer	3468	3345	Leipsic	Found.....	1.5	8.5	10.2	2.7	.....
National Fertilizer Co., Nashville, Tenn.									
Old Hickory Guano	3538	.....	.....	Guaranteed	1.6	2.0	8.0	1.0	.....
Old Hickory Guano	3538	3346	Belleview ...	Found.....	1.8	1.5	9.1	5.6	.....
Ammoniated Dissolved Bone	3581	.....	.....	Guaranteed	0.8	1.0	10.0	1.0	.....
Ammoniated Dissolved Bone	3581	3347	Velpen	Found.....	1.1	1.2	11.2	3.2	.....
National Grain Grower	3583	.....	.....	Guaranteed	1.6	2.0	8.0	1.0	.....
National Grain Grower	3583	3348	Velpen	Found.....	1.5	2.0	11.0	2.9	.....
National Acid Phosphate and Potash	3584	.....	.....	Guaranteed	....	2.0	10.0	1.0	.....
National Acid Phosphate and Potash	3584	3349	Belleview ...	Found.....	....	2.4	11.2	5.3	.....
National High Grade Dissolved Bone	3585	.....	.....	Guaranteed	....	.....	14.0	1.0	.....
National High Grade Dissolved Bone	3585	3350	Belleview ...	Found.....	....	.....	14.7	2.5	.....
National High Grade Dissolved Bone	3585	3351	Birdseye	Found.....	....	.....	16.0	2.1	.....
National Acid Phosphate	3586	.....	.....	Guaranteed	....	.....	12.0	1.0	.....
National Acid Phosphate	3586	3352	Mentor	Found.....	....	.....	14.3	2.7	.....
Norris Fertilizer Co., Rushville, Ind.									
Norris High Grade Bone and Potash	3469	.....	.....	Guaranteed	....	4.0	10.0	.....	.....
Norris High Grade Bone and Potash	3469	3353	Rensselaer ..	Found.....	....	3.8	10.8	0.6	.....
Norris High Grade Bone and Potash	3469	3354	Bloomington	Found.....	....	4.3	11.9	0.3	.....
Norris High Grade Bone and Potash	3469	3355	Rushville	Found.....	....	3.6	12.0	0.7	.....
Norris Bone and Potash	3470	.....	.....	Guaranteed	....	2.0	10.0	.....	.....
Norris Bone and Potash	3470	3356	Bloomington	Found.....	....	2.4	10.7	0.6	.....
Norris Bone and Potash	3470	3357	Rushville ...	Found.....	....	2.9	10.0	0.9	.....
Norris Soluble Bone Phosphate	3471	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Norris Soluble Bone Phosphate	3471	3358	Bloomington	Found.....	....	.....	16.7	0.5	.....
Norris Soluble Bone Phosphate	3471	3359	Bloomington	Found.....	....	.....	14.5	0.2	.....
Norris Soluble Bone Phosphate	3471	3360	Rushville ...	Found.....	....	.....	15.9	0.2	.....
Norris Special Fish Guano	3472	.....	.....	Guaranteed	1.2	2.0	8.0	2.0	.....
Norris Special Fish Guano	3472	3361	Bloomington	Found.....	1.6	2.4	8.0	5.1	.....
Norris Special Fish Guano	2472	3362	Rushville ...	Found.....	1.4	2.4	9.4	1.2	.....
Norris X Rush County Special	3473	.....	.....	Guaranteed	....	.....	16.0	.....	.....
Norris X Rush County Special	3473	3363	Rushville ...	Found.....	....	.....	16.9	0.3	.....
Norris Electric Wheat Maker	3474	.....	.....	Guaranteed	....	2.5	12.0	1.0	.....
Norris Electric Wheat Maker	3474	3364	Bloomington	Found.....	....	2.6	14.4	0.9	.....
Norris Electric Wheat Maker	3474	3365	Rushville ...	Found.....	....	2.1	13.2	0.4	.....
Norris Steamed Bone	3632	.....	.....	Guaranteed	3.0	.....	.....	.....	20.0
Norris Steamed Bone	3632	3366	Bloomington	Found.....	2.7	.....	.....	.....	20.9
Norris Steamed Bone	3632	3367	Rushville ...	Found.....	2.7	.....	.....	.....	23.0
North Western Fertilizing Co., Chicago, Ills.									
Horse Shoe Brand, Pure Ground Bone	2857	.....	.....	Guaranteed	2.4	.....	.....	.....	20.0
Horse Shoe Brand, Pure Ground Bone	2857	3368	Columbus ...	Found.....	2.8	.....	.....	.....	22.6
Horse Shoe Brand, Fine Raw Bone	2858	.....	.....	Guaranteed	3.2	.....	.....	.....	22.0
Horse Shoe Brand, Fine Raw Bone	2858	3369	Mitchell	Found.....	3.0	.....	.....	.....	22.2

1. Manufactured and sold by The Wuichet Fertilizer Co., Successors to Jas. McCallum & Co.

Report of Inspections—Continued.

LABEL	Number		Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
	Official	Inspection B							
North Western Fertilizing Co., Chicago, Ills.									
Horse Shoe Brand, Corn and Wheat Grower	2860	.....	.....	Guaranteed	1.6	2.0	8.0	.....	.....
Horse Shoe Brand, Corn and Wheat Grower	2860	3370	Salem	Found.....	1.7	2.2	7.2	5.2	.....
Horse Shoe Brand, Corn and Wheat Grower	2860	3371	Velpen	Found.....	1.6	1.9	6.9	5.2	.....
Horse Shoe Brand, Corn and Wheat Grower	2860	3372	Bloomington	Found.....	1.6	2.0	10.8	1.1	.....
Horse Shoe Brand, Corn and Wheat Grower	2860	3373	Evansville ...	Found.....	1.8	2.2	8.3	3.1	.....
Horse Shoe Brand, Bone and Potash....	2861	.....	.....	Guaranteed	....	2.0	10.0	.....	.....
Horse Shoe Brand, Bone and Potash....	2861	3374	Milan	Found.....	....	2.2	9.3	1.4	.....
Horse Shoe Brand, Bone and Potash....	2861	3375	Columbus ...	Found.....	....	2.0	9.5	4.3	.....
Horse Shoe Brand, Acidulated Bone and Potash	2863	.....	.....	Guaranteed	0.8	1.0	10.0	.....	.....
Horse Shoe Brand, Acidulated Bone and Potash	2863	3376	Evansville ..	Found.....	1.1	1.3	10.6	2.0	.....
Horse Shoe Brand, Quick Acting Phosphate	2865	.....	.....	Guaranteed	....	.....	10.0	.....	.....
Horse Shoe Brand, Quick Acting Phosphate	2865	3377	Depauw	Found.....	....	.....	9.3	1.5	.....
Horse Shoe Brand, National Bone Dust.	2866	.....	.....	Guaranteed	2.0	1.5	8.0	.....	.....
Horse Shoe Brand, National Bone Dust.	2866	3378	Salem	Found.....	2.1	1.5	7.3	5.6	.....
Horse Shoe Brand, National Bone Dust.	2866	3379	Campbellsburg	Found.....	2.0	1.5	9.7	3.6	.....
Horse Shoe Brand, National Bone Dust.	2866	3380	New Albany..	Found.....	2.0	1.7	8.2	5.9	.....
Horse Shoe Brand, Garden City Super Phosphate	2867	.....	.....	Guaranteed	2.0	1.5	8.0	.....	.....
Horse Shoe Brand, Garden City Super Phosphate	2867	3381	Columbus ...	Found.....	2.2	1.8	8.1	4.2	.....
Horse Shoe Brand, Garden City Super Phosphate	2867	3382	Bloomington	Found.....	2.0	1.7	8.1	5.4	.....
Horse Shoe Brand, Challenge Corn Grower	2868	.....	.....	Guaranteed	2.0	1.5	8.0	.....	.....
Horse Shoe Brand, Challenge Corn Grower	2868	3383	Mitchell	Found.....	2.1	1.6	7.4	5.4	.....
Muriate of Potash	3323	.....	.....	Guaranteed	....	50.0	.....	.....	.....
Muriate of Potash	3323	3384	Milan	Found.....	....	51.4	.....	.....	.....
Horse Shoe Brand, Special Bone Meal..	3517	.....	.....	Guaranteed	1.2	.....	.....	.....	25.0
Horse Shoe Brand, Special Bone Meal..	3517	3385	Milan	Found.....	1.3	.....	.....	.....	26.5
Horse Shoe Brand, Special Bone Meal..	2517	3386	Mitchell	Found.....	1.4	.....	.....	.....	28.1
Horse Shoe Brand, Special Potato Grower	3601	.....	.....	Guaranteed	2.0	5.0	8.0	2.0	.....
Horse Shoe Brand, Special Potato Grower	3601	3387	Milan	Found.....	2.1	5.0	7.1	5.0	.....
Horse Shoe Brand, Special Potato Grower	3601	3388	Gosport	Found.....	1.9	4.2	10.8	3.5	.....
Ohio Farmers Fertilizer Co., Columbus, O.									
Soluble Bone and Potash	2945	.....	.....	Guaranteed	....	2.0	8.0	1.0	.....
Soluble Bone and Potash	2945	3389	Washington .	Found.....	....	1.1	10.5	3.9	.....
Corn, Oats and Wheat Fish Guano.....	2947	.....	.....	Guaranteed	1.2	2.0	8.0	2.0	.....
Corn, Oats and Wheat Fish Guano.....	2947	3390	Washington ..	Found.....	0.5	0.7	8.0	2.9	.....
No. 1 Potato and Tobacco Special.....	3207	.....	.....	Guaranteed	1.6	4.0	8.0	1.0	.....
No. 1 Potato and Tobacco Special.....	3207	3391	Campbellsburg	Found.....	0.7	3.4	9.6	1.1	.....
No. 1 Potato and Tobacco Special.....	3207	3392	Brooksburg ..	Found.....	0.7	3.3	9.8	1.0	.....
Wheat Maker and Seeding Down.....	3208	.....	.....	Guaranteed	0.4	2.5	8.0	1.0	.....
Wheat Maker and Seeding Down.....	3208	3393	Washington .	Found.....	0.3	2.1	9.0	2.1	.....
"A" General Crop Fish Guano.....	3306	.....	.....	Guaranteed	0.8	1.0	7.0	1.0	.....
"A" General Crop Fish Guano.....	3306	3394	Washington .	Found.....	0.5	0.6	7.6	3.0	.....
Raw Bone Meal.....	3351	.....	.....	Guaranteed	1.2	.....	.....	.....	27.0
Raw Bone Meal.....	3351	3395	Orleans	Found.....	0.9	.....	.....	.....	34.2
Alkaline Bone	3417	.....	.....	Guaranteed	....	.....	14.0	1.0	.....
Alkaline Bone	3417	3396	Mt. Carmel ..	Found.....	....	.....	14.7	2.1	.....
"A" Soluble Bone and Potash.....	3418	.....	.....	Guaranteed	....	1.0	11.0	1.0	.....
"A" Soluble Bone and Potash.....	3418	3397	Washington .	Found.....	....	0.9	10.9	3.7	.....
Packers Fertilizer Association, Chicago, Ills.									
Boars Head Brand, Chicago Bone Meal.	2851	.....	.....	Guaranteed	2.4	.....	.....	.....	20.0
Boars Head Brand, Chicago Bone Meal.	2851	3398	Jasper	Found.....	2.5	.....	.....	.....	22.0
Boars Head Brand, Chicago Bone Meal.	2851	3399	Vienna	Found.....	2.4	.....	.....	.....	22.4
Boars Head Brand, Ammoniated Bone and Potash	2852	.....	.....	Guaranteed	0.8	1.0	10.0	.....	.....
Boars Head Brand, Ammoniated Bone and Potash	2852	3400	Nulltown	Found.....	0.9	1.2	9.9	2.3	.....
Boars Head Brand, Potash Phosphate...	2853	.....	.....	Guaranteed	....	4.0	10.0	.....	.....

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Packers Fertilizer Association, Chicago, Ills.									
Boars Head Brand, Potash Phosphate...	2853	3401	Goodland	Found.....	....	3.3	9.4	1.2	.....
Boars Head Brand, Potash Phosphate...	2853	3402	Jasper	Found.....	....	3.4	10.5	1.4	.....
Boars Head Brand, Sure Growth Phosphate	2854	.....	.....	Guaranteed	0.8	.....	10.0	.....	.....
Boars Head Brand, Sure Growth Phosphate	2854	3403	Jasper	Found.....	0.8	.....	10.5	3.1	.....
Boars Head Brand, Sure Growth Phosphate	2854	3404	Jasper	Found.....	0.9	.....	8.3	3.7	.....
Boars Head Brand, Soluble Phosphate..	2855	.....	.....	Guaranteed	....	.....	10.0	.....	.....
Boars Head Brand, Soluble Phosphate..	2855	3405	Jasper	Found.....	....	.....	9.2	5.0	.....
Boars Head Brand, Soluble Phosphate..	2855	3406	Jasper	Found.....	....	.....	10.9	1.5	.....
Boars Head Brand, World of Good Superphosphate	2856	.....	.....	Guaranteed	2.0	1.5	8.0	.....	.....
Boars Head Brand, World of Good Superphosphate	2856	3407	Scottsburg ..	Found.....	2.1	1.8	6.9	4.7	.....
Boars Head Brand, World of Good Superphosphate	2856	3408	Nulltown	Found.....	2.1	1.8	8.2	3.9	.....
Boars Head Brand, World of Good Superphosphate	2856	3409	Salem	Found.....	2.0	1.5	9.1	6.2	.....
Boars Head Brand, Gilt Edge Phosphate	3277	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Boars Head Brand, Gilt Edge Phosphate	3277	3410	Jasper	Found.....	..	.....	12.6	3.6	.....
Boars Head Brand, Gilt Edge Phosphate	3277	3411	Depauw	Found.....	....	.....	14.4	1.1	.....
Boars Head Brand, Special Bone Meal..	3518	.....	.....	Guaranteed	1.2	.....	.....	.....	25.0
Boars Head Brand, Special Bone Meal..	3518	3412	Salem	Found.....	1.2	.....	.....	.....	27.8
Packers Fertilizer Co., The St. Bernard, O.									
Hinchman's Acidulated Bone and Potash	3238	.....	.....	Guaranteed	....	2.0	10.0	.....	.....
Hinchman's Acidulated Bone and Potash	3238	3413	Milan	Found.....	....	1.4	9.1	1.4	.....
Hinchman's Acidulated Bone and Potash	3238	3414	Orleans	Found.....	....	2.0	10.5	3.3	.....
Hinchman's Acidulated Bone.....	3239	.....	.....	Guaranteed	....	.....	14.0	2.0	.....
Hinchman's Acidulated Bone.....	3239	3415	Orleans	Found.....	....	.....	13.4	2.7	.....
Hinchman's Sweepstakes Bone.....	3240	.....	.....	Guaranteed	0.4	2.0	9.0	1.0	.....
Hinchman's Sweepstakes Bone.....	3240	3416	Franklin	Found.....	0.9	2.1	7.5	3.5	.....
Hinchman's Bone Phosphate.....	3242	.....	.....	Guaranteed	0.8	1.0	10.0	1.0	.....
Hinchman's Bone Phosphate.....	3242	3417	Orlenas	Found.....	0.7	0.8	10.0	2.1	.....
Hinchman's Bone Meal.....	3243	.....	.....	Guaranteed	2.5	.....	.....	.....	20.0
Hinchman's Bone Meal.....	3243	3418	Orleans	Found.....	1.9	.....	.....	.....	27.3
Hinchman's Bone Meal.....	3243	3419	St. Paul	Found.....	1.9	.....	.....	.....	29.3
Packers Fertilizer Co., Cincinnati, Ohio.									
Sweepstakes Bone	3436	.....	.....	Guaranteed	0.8	2.0	10.0	1.0	.....
Sweepstakes Bone	3436	3420	Orleans	Found.....	1.0	2.0	8.4	2.2	.....
Sweepstakes Bone	3436	3421	Orleans	Found.....	1.1	2.2	7.5	3.5	.....
Acidulated Bone	3490	.....	.....	Guaranteed	....	.....	14.0	2.0	.....
Acidulated Bone	3490	3422	Orleans	Found.....	....	.....	13.6	1.9	.....
Bone Phosphate	3491	.....	.....	Guaranteed	0.8	1.0	10.0	1.0	.....
Bone Phosphate	3491	3423	Salem	Found.....	0.8	1.4	9.7	2.5	.....
Bone Phosphate	3491	3424	Orleans	Found.....	0.8	1.1	9.8	2.7	.....
Acidulated Bone and Potash.....	3492	.....	.....	Guaranteed	....	2.0	10.0	1.0	.....
Acidulated Bone and Potash.....	3492	3425	Orleans	Found.....	....	2.0	8.9	3.0	.....
Bone Meal	3493	.....	.....	Guaranteed	2.5	.....	.....	.....	20.0
Bone Meal	3493	3426	Bath	Found.....	1.6	.....	.....	.....	26.4
Bone Meal	3493	3427	Orleans	Found.....	1.8	.....	.....	.....	26.9
Packer Fertilizer Co., Indianapolis, Ind.									
Packer's Bone	3247	.....	.....	Guaranteed	2.4	.....	.....	.....	25.0
Packer's Bone	3247	3428	Evansville ...	Found.....	1.6	.....	.....	.....	30.0
Packer's Half and Half.....	3248	.....	.....	Guaranteed	2.0	.....	8.5	6.5	.....
Packer's Half and Half.....	3248	3429	Evansville ...	Found.....	1.1	.....	12.1	4.3	.....
Packer's Phosphate and Potash.....	3252	.....	.....	Guaranteed	....	2.0	10.0	.....	.....
Packer's Phosphate and Potash.....	3252	3430	Evansville ...	Found.....	....	1.8	10.7	1.7	.....
Packer's Superphosphate	3253	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Packer's Superphosphate	3253	3431	Evansville ...	Found.....	....	.....	14.2	1.1	.....
Standard Phosphate	3254	.....	.....	Guaranteed	....	.....	10.0	.....	.....
Standard Phosphate	3254	3432	Weisburg	Found.....	....	.....	9.2	2.0	.....
Packer's Dissolved Bone.....	3266	.....	.....	Guaranteed	....	4.0	10.0	.....	.....
Packer's Dissolved Bone.....	3266	3433	Adams	Found.....	....	3.4	9.3	1.3	.....
Our Wheat Grower.....	3558	.....	.....	Guaranteed	0.8	1.0	7.0	1.0	.....
Our Wheat Grower.....	3558	3434	Brookville ...	Found.....	0.8	1.3	8.4	2.6	.....
Corn and Wheat Special.....	3559	.....	.....	Guaranteed	0.8	2.0	8.0	1.0	.....

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Packer Fertilizer Co., Indianapolis, Ind.									
Corn and Wheat Special	3559	3435	Rushville	Found	0.7	1.7	8.3	2.2	.....
Our Complete Fertilizer	3560	.....	.....	Guaranteed	0.8	3.0	8.0	1.0	.....
Our Complete Fertilizer	3560	3436	Weisburg	Found	0.8	3.1	9.2	2.7	.....
Pero & Stoecker, Louisville, Ky.									
Pure Potato Grower	3622	.....	.....	Guaranteed	3.5	6.0	.....	.....	10.0
Pure Potato Grower	3622	3437	Lanesville	Found	4.3	5.5	.....	.....	11.1
Pure Animal Matter Corn and Wheat Grower	3623	.....	.....	Guaranteed	3.5	.....	.....	.....	10.0
Pure Animal Matter Corn and Wheat Grower	3623	3438	Lanesville	Found	4.9	.....	.....	.....	12.5
Pure Animal Matter Corn and Wheat Grower	3623	3439	Georgetown	Found	4.1	.....	.....	.....	17.7
Rauh & Sons Fertilizer Co., E. Indianapolis, Ind.									
Rauh's Ideal Phosphate	3185	.....	.....	Guaranteed	....	.....	10.0	.....	.....
Rauh's Ideal Phosphate	3185	3440	Peoria	Found	....	.....	10.4	1.8	.....
Rauh's Red Star Phosphate	3186	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Rauh's Red Star Phosphate	3186	3441	Madison	Found	....	.....	14.6	1.4	.....
Rauh's Red Star Phosphate	3186	3442	French Lick	Found	....	.....	13.3	1.9	.....
Rauh's Red Star Phosphate	3186	3443	Sunman	Found	....	.....	12.3	2.6	.....
Rauh's Phosphate and Potash	3189	.....	.....	Guaranteed	....	2.0	10.0	.....	.....
Rauh's Phosphate and Potash	3189	3444	Peoria	Found	....	1.7	10.7	1.6	.....
Rauh's Peerless Bone	3191	.....	.....	Guaranteed	1.6	4.0	10.0	.....	.....
Rauh's Peerless Bone	3191	3445	Madison	Found	1.4	3.6	11.6	3.2	.....
Rauh's Special	3192	.....	.....	Guaranteed	1.6	6.0	10.0	.....	.....
Rauh's Special	3192	3446	Campbellsburg	Found	1.1	5.0	11.2	4.5	.....
Rauh's Special	3192	3447	Orleans	Found	1.7	7.4	9.7	3.6	.....
Rauh's Half Pure Raw Bone and Half Pure Bone Phosphate	3193	.....	.....	Guaranteed	1.2	.....	8.5	11.0	.....
Rauh's Half Pure Raw Bone and Half Pure Bone Phosphate	3193	3448	Peoria	Found	1.6	.....	8.3	8.9	.....
Rauh's Half Pure Raw Bone and Half Pure Bone Phosphate	3193	3449	Trafalgar	Found	0.9	.....	7.9	9.1	.....
Rauh's Lawnmere	3194	.....	.....	Guaranteed	1.0	.....	8.5	10.0	.....
Rauh's Lawnmere	3194	3450	Logansport	Found	1.1	.....	10.5	11.5	.....
Rauh's Pure Ground Bone	3195	.....	.....	Guaranteed	2.4	.....	.....	.....	22.0
Rauh's Pure Ground Bone	3195	3451	Lexington	Found	1.9	.....	.....	.....	29.6
Rauh's Pure Ground Bone	3195	3452	Orleans	Found	2.2	.....	.....	.....	27.9
Rauh's Pig Foot Bone	3196	.....	.....	Guaranteed	2.4	.....	.....	.....	22.0
Rauh's Pig Foot Bone	3196	3453	Jasper	Found	1.8	.....	.....	.....	29.0
Sulphate of Potash	3197	.....	.....	Guaranteed	....	48.5	.....	.....	.....
Sulphate of Potash	3197	3454	Dupont	Found	....	49.6	.....	.....	.....
Rauh's Grain Grower	3302	.....	.....	Guaranteed	....	4.0	10.0	.....	.....
Rauh's Grain Grower	3302	3455	Jasper	Found	....	1.8	12.7	1.8	.....
Rauh's Grain Grower	3302	3456	Columbus	Found	....	3.3	9.0	1.1	.....
Our Soluble Bone	3552	.....	.....	Guaranteed	0.8	1.0	7.0	1.0	.....
Our Soluble Bone	3552	3458	Campbellsburg	Found	0.9	2.0	7.8	4.4	.....
Our Soluble Bone	3552	3459	Columbus	Found	0.9	1.6	7.6	3.1	.....
Corn and Wheat Grower	3553	.....	.....	Guaranteed	0.8	2.0	8.0	1.0	.....
Corn and Wheat Grower	3553	3460	Campbellsburg	Found	0.8	1.6	8.4	4.7	.....
Corn and Wheat Grower	3553	3461	Columbus	Found	1.0	2.4	9.0	2.7	.....
Our Dissolved Bone and Potash	3554	.....	.....	Guaranteed	0.8	3.0	8.0	1.0	.....
Our Dissolved Bone and Potash	3554	3462	Scottsburg	Found	0.6	2.8	9.6	3.1	.....
Our Dissolved Bone and Potash	3554	3463	Eckerty	Found	0.7	3.7	9.6	2.1	.....
Read Phosphate Co., Nashville, Tenn.									
Read's Blood and Bone Fertilizer No. One	3037	.....	.....	Guaranteed	1.6	2.0	8.0	1.0	.....
Read's Blood and Bone Fertilizer No. One	3037	3464	Eckerty	Found	1.8	2.7	6.7	5.6	.....
Read's Blood and Bone Fertilizer No. One	3037	3465	Seymour	Found	2.2	2.5	9.6	3.5	.....
Read's Wheat and Clover Grower	3038	.....	.....	Guaranteed	0.8	2.0	10.0	1.0	.....
Read's Wheat and Clover Grower	3038	3466	Worthington	Found	1.1	2.3	10.6	1.9	.....
Read's Dissolved Bone Phosphate	3039	.....	.....	Guaranteed	....	.....	10.0	1.0	.....
Read's Dissolved Bone Phosphate	3039	3467	French Lick	Found	....	.....	12.3	5.2	.....
Read's High Grade Acid Phosphate	3040	.....	.....	Guaranteed	....	.....	14.0	1.0	.....
Read's High Grade Acid Phosphate	3040	3468	French Lick	Found	....	.....	14.7	3.5	.....

Report of Inspections—Continued.

LABEL	Number		Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
	Official	Inspection B							
Read Phosphate Co., Nashville, Tenn.									
Read's High Grade Acid Phosphate	3040	3469	Worthington	Found	....	.....	13.8	2.3	.....
Read's Bone and Potash	3042	.....	.....	Guaranteed	....	2.0	10.0	1.0	.....
Read's Bone and Potash	3042	3470	French Lick	Found	....	1.5	10.7	3.5	.....
Read's Bone and Potash	3042	3471	Seymour	Found	....	2.4	12.4	1.5	.....
Fine Ground Bone	3043	.....	.....	Guaranteed	2.0	.....	.....	.....	20.2
Fine Ground Bone	3043	3472	Worthington	Found	2.3	.....	.....	.....	13.8
Muriate of Potash	3044	.....	.....	Guaranteed	....	49.0	.....	.....	.....
Muriate of Potash	3044	3473	Salem	Found	....	49.9	.....	.....	.....
Muriate of Potash	3044	3474	Hagerstown	Found	....	50.0	.....	.....	.....
Nitrate of Soda	3045	.....	.....	Guaranteed	14.7	.....	.....	.....	.....
Nitrate of Soda	3045	3475	Salem	Found	15.7	.....	.....	.....	.....
Read's Corn Grower Special	3284	.....	.....	Guaranteed	0.8	1.0	10.0	1.0	.....
Read's Corn Grower Special	3284	3476	Eckerty	Found	1.3	1.8	8.7	5.6	.....
Schmadel, Louis, Evansville, Ind.									
Schmadel's Bone Meal	2961	.....	.....	Guaranteed	4.0	.....	.....	.....	16.0
Schmadel's Bone Meal	2961	3477	Evansville	Found	3.7	.....	.....	.....	21.2
Schmadel's Bone Meal	2961	3478	Evansville	Found	3.4	.....	.....	.....	21.3
Schmadel's Mixed Fertilizer	3371	.....	.....	Guaranteed	2.0	.....	8.0	8.0	.....
Schmadel's Mixed Fertilizer	3371	3479	Evansville	Found	2.9	.....	6.6	6.2	.....
Southern Indiana Fertilizer Co., Boonville Ind.									
Soluble Bone	3125	.....	.....	Guaranteed	1.2	.....	10.0	.....	.....
Soluble Bone	3125	3480	Boonville	Found	1.7	.....	7.2	1.6	.....
Raw Bone Meal	3343	.....	.....	Found	3.0	.....	.....	.....	22.0
Raw Bone Meal	3343	3481	Boonville	Found	3.1	.....	.....	.....	20.5
Soluble Bone and Potash	3373	.....	.....	Guaranteed	1.0	4.0	10.0	.....	.....
Soluble Bone and Potash	3373	3482	Boonville	Found	1.2	4.3	8.3	1.2	.....
Bone Meal	3659	.....	.....	Guaranteed	2.0	.....	.....	.....	20.0
Bone Meal	3659	3483	Boonville	Found	2.5	.....	.....	.....	27.6
Star Tankage and Fertilizer Works, Vincennes, Ind.									
Star Raw Bone Meal	3382	.....	.....	Guaranteed	2.9	.....	.....	.....	20.0
Star Raw Bone Meal	3382	3484	Jasper	Found	3.1	.....	.....	.....	22.2
Star Melon, Corn and Potato Grower	3489	.....	.....	Guaranteed	2.9	2.5	10.0	3.9	.....
Star Melon, Corn and Potato Grower	3489	3485	Vincennes	Found	2.4	3.0	9.4	2.6	.....
"A" Star Wheat Grower	3663	.....	.....	Guaranteed	4.0	.....	5.1	5.8	.....
"A" Star Wheat Grower	3663	3486	Jasper	Found	4.4	.....	7.5	6.2	.....
St. John Chas. E., Greensburg, Ind.									
Animal Matter	3359	.....	.....	Guaranteed	3.0	.....	.....	.....	14.0
Animal Matter	3359	3487	Greensburg	Found	3.2	.....	.....	.....	16.8
Swift & Company, Chicago, Ills.									
Swift's Superphosphate	2715	.....	.....	Guaranteed	1.6	2.0	8.0	4.0	.....
Swift's Superphosphate	2715	3488	Cannellton	Found	1.9	2.0	7.2	4.0	.....
Swift's Superphosphate	2715	3489	Delaware	Found	1.7	2.0	7.9	2.5	.....
Swift's Superphosphate	2715	3490	Salem	Found	1.7	2.1	7.7	6.0	.....
Swift's Garden City Phosphate	2716	.....	.....	Guaranteed	....	.....	14.0	.....	.....
Swift's Garden City Phosphate	2716	3491	Lost River	Found	....	.....	13.7	0.8	.....
Swift's Garden City Phosphate	2716	3492	Elberfeld	Found	....	.....	**14.0**	**0.7**	.....
Swift's Pure Raw Bone Meal	2755	.....	.....	Guaranteed	3.7	.....	.....	.....	23.0
Swift's Pure Raw Bone Meal	2755	3493	Liberty	Found	4.2	.....	.....	.....	24.5
Swift's Pure Raw Bone Meal	2755	3494	Martinsville	Found	4.1	.....	.....	.....	25.1
Swift's Bone Meal	2756	.....	.....	Guaranteed	2.5	.....	.....	.....	25.0
Swift's Bone Meal	2756	3495	Eckerty	Found	2.5	.....	.....	.....	27.0
Swift's Diamond S Phosphate	2757	.....	.....	Guaranteed	....	.....	10.0	.....	.....
Swift's Diamond S Phosphate	2757	3496	Lost River	Found	....	.....	10.0	0.6	.....
Swift's Diamond S Phosphate	2757	3497	St. Anthony	Found	....	.....	10.4	0.8	.....
Swift's Complete Fertilizer	2760	.....	.....	Guaranteed	1.0	1.0	8.0	3.0	.....
Swift's Complete Fertilizer	2760	3498	Salem	Found	1.1	1.3	7.9	1.8	.....
Swift's Complete Fertilizer	2760	3499	Eckerty	Found	1.1	1.1	8.5	5.4	.....
Swift's Ammoniated Bone and Potash	2761	.....	.....	Guaranteed	4.7	3.0	.....	.....	16.0
Swift's Ammoniated Bone and Potash	2761	3500	Elberfeld	Found	4.4	1.8	.....	.....	19.3
Swift's Bone and Potash	2762	.....	.....	Guaranteed	2.5	3.0	.....	.....	23.5
Swift's Bone and Potash	2762	3501	Duff	Found	4.2	0.1	.....	.....	24.9
Swift's Special Bone Meal	3084	.....	.....	Guaranteed	0.8	.....	.....	.....	27.5
Swift's Special Bone Meal	3084	3502	Salem	Found	1.3	.....	.....	.....	31.2

Report of Inspections—Continued.

LABEL	Number Official	Number Inspection B	Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
Swift & Company, Chicago, Ills.									
Swift's Special Bone Meal	3084	3503	Martinsville	Found	1.0	.....	.....	.....	32.1
Swift's Champion Wheat and Corn Grower	3443	.....	.....	Guaranteed	1.6	2.0	12.0	1.0	.....
Swift's Champion Wheat and Corn Grower	3443	3504	Martinsville	Found	1.7	2.3	10.2	3.9	.....
Swift's Onion, Potato and Tobacco	3444	.....	.....	Guaranteed	1.6	7.0	8.0	3.0	.....
Swift's Onion, Potato and Tobacco	3444	3505	Lost River	Found	1.6	5.5	7.1	3.5	.....
Swift's Special Phosphate and Potash	3445	.....	.....	Guaranteed	....	2.0	10.0	1.0	.....
Swift's Special Phosphate and Potash	3445	3506	Lost River	Found	....	1.8	9.5	0.5	.....
Swift's Bone Meal and Blood	3513	.....	.....	Guaranteed	3.7	.....	.....	.....	23.0
Swift's Bone Meal and Blood	3513	3507	Eckerty	Found	3.6	.....	.....	.....	23.2
Swift's Truck Grower	3603	.....	.....	Guaranteed	0.8	4.0	8.0	2.0	.....
Swift's Truck Grower	3603	3508	Cannellton	Found	0.9	4.8	7.7	1.9	.....
Tennessee Chemical Co., Nashville, Tenn.									
Ox Alkaline Bone with Ammonia	2778	.....	.....	Guaranteed	0.2	0.5	9.5	.....	.....
Ox Alkaline Bone with Ammonia	2778	3509	Osgood	Found	0.5	1.2	10.8	0.6	.....
Ox Corn and Wheat Grower	3269	.....	.....	Guaranteed	0.1	0.5	10.0	1.0	.....
Ox Corn and Wheat Grower	3269	3510	Osgood	Found	0.3	0.6	9.5	0.7	.....
Ox Special Wheat Grower	3329	.....	.....	Guaranteed	0.8	1.0	7.0	1.0	.....
Ox Special Wheat Grower	3329	3511	Osgood	Found	0.8	1.0	5.6	3.9	.....
Ox Special Wheat Grower	3329	3512	Corydon Junc	Found	1.3	1.2	7.1	1.8	.....
Ox Indiana Dissolved Bone	3332	.....	.....	Guaranteed	....	.....	14.0	1.0	.....
Ox Indiana Dissolved Bone	3332	3513	Salem	Found	....	.....	13.5	1.9	.....
Ox Indiana Dissolved Bone	3332	3514	Bloomington	Found	....	.....	13.7	1.4	.....
Ox Indiana Phosphate	3333	.....	.....	Guaranteed	....	.....	12.0	1.0	.....
Ox Indiana Phosphate	3333	3515	Corydon Junc	Found	....	.....	12.2	1.3	.....
Ox Indiana Potash Mixture	3334	.....	.....	Guaranteed	....	2.0	10.0	1.0	.....
Ox Indiana Potash Mixture	3334	3516	Nevin	Found	....	2.1	9.9	1.0	.....
Ox Indiana Potash Mixture	3334	3517	Osgood	Found	....	3.2	8.7	0.8	.....
Ox Indiana Alkaline Bone	3338	.....	.....	Guaranteed	....	2.0	12.0	1.0	.....
Ox Indiana Alkaline Bone	3338	3518	Nevin	Found	....	2.0	12.2	0.4	.....
Ox Indiana Slaughter House Bone	3442	.....	.....	Guaranteed	1.6	2.0	8.0	1.0	.....
Ox Indiana Slaughter House Bone	3442	3519	Nevin	Found	1.3	2.2	11.4	1.5	.....
Ox Indiana Ammoniated Bone	3457	.....	.....	Guaranteed	1.6	2.0	10.0	1.0	.....
Ox Indiana Ammoniated Bone	3457	3520	Nevin	Found	1.4	2.3	11.6	1.7	.....
Ox Indiana Ammoniated Bone	3457	3521	Vevay	Found	1.3	1.8	10.6	1.3	.....
Franklin County Wheat Grower	3531	.....	.....	Guaranteed	....	.....	16.0	1.0	.....
Franklin County Wheat Grower	3531	3522	Salem	Found	....	.....	13.4	2.9	.....
Tuscarora Fertilizer Co., Chicago, Ills.									
Tuscarora Raw Bone	3461	.....	.....	Guaranteed	3.7	.....	.....	.....	22.0
Tuscarora Raw Bone	3461	3523	Batesville	Found	3.8	.....	.....	.....	25.2
Tuscarora Raw Bone	3461	3524	Corydon Junc	Found	3.7	.....	.....	.....	25.6
Ammoniated Phosphate	3462	.....	.....	Guaranteed	0.8	1.0	7.0	2.0	.....
Ammoniated Phosphate	3462	3525	Marengo	Found	0.9	1.5	6.2	1.9	.....
Tuscarora Standard	3463	.....	.....	Guaranteed	1.6	2.0	8.0	2.0	.....
Tuscarora Standard	3463	3526	Francesville	Found	1.5	2.2	8.8	2.1	.....
Tuscarora Standard	3463	3527	Corydon Junc	Found	1.4	2.0	8.2	2.0	.....
Bone and Potash	3464	.....	.....	Guaranteed	....	2.0	10.0	2.0	.....
Bone and Potash	3464	3528	Marengo	Found	....	2.6	10.7	1.1	.....
Bone and Potash	3464	3529	Milroy	Found	....	2.2	10.6	1.0	.....
Acid Phosphate	3465	.....	.....	Guaranteed	....	.....	14.0	2.0	.....
Acid Phosphate	3465	3530	Marengo	Found	....	.....	16.6	0.1	.....
Animal Bone	3466	.....	.....	Guaranteed	2.4	.....	.....	.....	24.0
Animal Bone	3466	3531	Francesville	Found	2.6	.....	.....	.....	25.3
Animal Bone	3466	3532	Corydon Junc	Found	3.0	.....	.....	.....	26.1
Tuscarora Steamed Bone	3530	.....	.....	Guaranteed	1.6	.....	.....	.....	20.0
Tuscarora Steamed Bone	3530	3533	Francesville	Found	2.9	.....	.....	.....	24.9
Tuscarora Steamed Bone	3530	3534	Batesville	Found	2.1	.....	.....	.....	24.4
A. B. Norris Fertilizer Co., Brand "Soluble Dissolved Bone"	3612	.....	.....	Guaranteed	....	.....	14.0	2.0	.....
A. B. Norris Fertilizer Co., Brand "Soluble Dissolved Bone"	3612	3535	Pleasant Ridge	Found	....	.....	17.1	0.2	.....
A. B. Norris Fertilizer Co., Brand "High Grade Bone and Potash"	3614	.....	.....	Guaranteed	....	4.0	10.0	2.0	.....
A. B. Norris Fertilizer Co., Brand "High Grade Bone and Potash"	3614	3536	Wolcott	Found	....	4.3	10.7	0.4	.....
Big (4) Four	3630	.....	.....	Guaranteed	1.6	4.0	7.0	.....	.....
Big (4) Four	3630	3537	Corydon Junc	Found	1.5	4.7	8.0	2.1	.....

Report of Inspections—Continued.

LABEL	Number		Sample Taken at		Nitrogen per cent.	Potash sol. in water per cent.	Soluble and Rev. Phos. Acid pr. ct.	Insoluble Phosphoric Acid pr. ct.	Total Phosphoric Acid per cent.
	Official	Inspection B							
Walton Fertilizer Co., The, Cincinnati, O.									
Diamond Cereala Soluble Bone	3155	.....	.....	Guaranteed	0.4	.....	15.0	1.0	.....
Diamond Cereala Soluble Bone	3155	3538	Connersville	Found	0.3	.....	15.5	1.8	.....
Weidman, Augustus, Hagerstown, Ind.									
"Wheat and Grass Grower"	3135	.....	.....	Guaranteed	1.5	1.7	9.0	1.5	.....
"Wheat and Grass Grower"	3135	3539	Hagerstown	Found	1.7	2.2	10.2	1.7	.....
Steamed Bone	3525	.....	.....	Guaranteed	0.5	.....	.....	.....	18.0
Steamed Bone	3525	3540	Hagerstown.	Found	1.8	.....	.....	.....	21.8
Acid Phosphate	3528	.....	.....	Guaranteed	....	.....	16.0	.....	.....
Acid Phosphate	3528	3541	Hagerstown.	Found	....	.....	14.4	1.7	.....
Western Fertilizer Works, Indianapolis, Ind.									
Wheat and Clover Grower	3396	.....	.....	Guaranteed	1.2	1.5	8.0	1.0	.....
Wheat and Clover Grower	3396	3542	Freetown	Found	0.9	2.1	8.6	2.7	.....
Wheat and Clover Grower	3396	3543	Osgood	Found	1.3	0.8	6.6	4.6	.....
Wheat and Corn Special	3397	.....	.....	Guaranteed	0.8	1.0	8.0	0.5	.....
Wheat and Corn Special	3397	3544	Owensburg	Found	0.7	1.1	8.9	4.3	.....
Complete Fertilizer	3398	.....	.....	Guaranteed	0.4	1.0	7.0	0.5	.....
Complete Fertilizer	3398	3545	Owensburg	Found	0.6	1.1	8.8	4.9	.....
Complete Fertilizer	3398	3546	Freetown	Found	0.7	1.3	8.0	2.8	.....
Bone Meal	3401	.....	.....	Guaranteed	1.7	.....	.....	.....	20.0
Bone Meal	3401	3547	Freetown	Found	2.1	.....	.....	.....	21.4
Wuichet Fertilizer Co., The, Dayton, Ohio.									
"Spot Cash Fertilizer"	3591	.....	.....	Guaranteed	1.5	2.0	10.0	2.0	.....
"Spot Cash Fertilizer"	3591	3548	Leipsic	Found	1.3	1.1	11.2	3.5	.....
"Ruby Phosphate"	3592	.....	.....	Guaranteed	0.5	1.0	10.0	1.0	.....
"Ruby Phosphate"	3592	3549	Crandall	Found	0.7	1.4	12.1	2.0	.....
"Onion and Truck Fertilizer"	3594	.....	.....	Guaranteed	1.5	8.0	8.0	1.0	.....
"Onion and Truck Fertilizer"	3594	3550	Nappanee	Found	1.3	5.2	8.4	2.6	.....
"Onion and Truck Fertilizer"	3594	3551	Butler	Found	0.9	4.9	9.7	2.8	.....
"Raw Bone and Phosphate"	3595	.....	.....	Guaranteed	2.0	1.0	10.0	5.0	.....
"Raw Bone and Phosphate"	3596	3552	Auburn	Found	1.1	1.2	11.3	4.3	.....
"Miami Phosphate"	3596	.....	.....	Guaranteed	1.0	3.0	9.0	1.0	.....
"Miami Phosphate"	3596	3553	Auburn	Found	0.7	1.8	10.5	2.4	.....
"Superior Pure Raw Bone"	3597	.....	.....	Guaranteed	3.0	.....	.....	.....	23.0
"Superior Pure Raw Bone"	3597	3554	Crandall	Found	3.3	.....	.....	.....	23.6
"Superior Pure Raw Bone"	3597	3555	Canaan	Found	3.5	.....	.....	.....	19.7

TABLE 3.—Brands Registered Under Act of March 11, 1901. These are the legal standard for brands now on sale in this State. No tag below No. 2715 can be legally used.

LABEL	Official Number	Guaranteed by the Manufacturers to contain not less than				
		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
Abbott & Martin Rend. Co., The, Columbus, O.						
Peerless Bone and Potash	2850	0.4	2.5	8.0	1.0	
Render's Bone Meal	2967	1.6				20.0
Harvest King	3210	1.2	2.0	8.0	1.0	
Tennessee Phosphate	3212			13.0	1.0	
Abbott's Ideal Grain Grower	3213	0.8	1.0	7.0	1.0	
Fine Raw Bone Meal	3352	1.2				27.0
Tobacco and Potato Special	3419	1.6	4.0	8.0	1.0	
Hercules Phosphate	3420	0.0	0.0	14.0	1.0	
"A" Tennessee Phosphate	3422	0.0	0.0	10.0	1.0	
No. 1 Star Phosphate	3714		2.0	10.0	1.0	
Akin Fertilizer Co., Evansville, Ind.						
Pure Raw Bone	2962	3.0				20.0
Bone Meal	2976	1.7	1.2	11.0	5.0	
Anderson Fertilizing Co., Anderson, Ind.						
A Soft Bone Fertilizer	3317	4.0				17.0
American Agri. Chem. Co., The, New York, N. Y.						
Quinnipiac Climax Phosphate	2793	1.0	2.0	8.0		
" Dissolved Bone and Potash	2794	0.0	2.0	10.0		
" Soluble Dissolved Bone	2795	0.0	0.0	14.0		
" Plain Superphosphate	2796	0.0	0.0	10.0		
" Special Corn and Wheat	2797	0.8	1.0	10.0		
" Ammoniated Dissolved Bone	2798	1.6	2.0	8.0		
" Mohawk Fertilizer	2799	0.8	1.0	7.0		
Cleveland Dryer, Tobacco, Potato & Gen. C. Fer	2800	0.8	4.0	10.0		
" " Horsehead Phosphate	2801	0.0	0.0	10.0		
" " Phospho Bone	2802	0.8	1.0	10.0		
" " XXX Superphosphate	2803	0.0	0.0	14.0		
" " Ohio Seed Maker with Potash	2804	1.6	2.0	8.0		
" " Ohio Seed Maker	2805	1.6	0.0	10.0		
" " Forest City Buckeye A.B.S.P.	2806	2.4	2.0	9.0		
Zell's Little Giant	2807	0.8	1.0	7.0		
" Dissolved S. C. Phosphate	2808	0.0	0.0	12.0		
" Dissolved Bone Phosphate	2809	0.0	0.0	14.0		
" Electric Phosphate	2810	0.0	2.0	10.0		
" Economizer	2811	0.8	2.0	8.0		
" Ammoniated Bone Superphosphate	2812	1.6	2.0	8.0		
Bradley's Corn and Wheat Phosphate	2813	0.8	1.0	10.0		
" B. D. Sea Fowl Guano	2814	2.0	1.5	8.0		
" Alkaline Bone and Potash	2815	0.0	2.0	10.0		
" Dissolved Bone with Potash	2816	1.0	2.0	8.0		
" Niagara Phosphate	2817	0.8	1.0	7.0		
" Dissolved Bone Justice Brand	2818	0.0	0.0	12.0		
" Potato and Root Phosphate	2819	0.8	4.0	8.0		
" Acid Phosphate	2820	0.0	0.0	10.0		
" Soluble Dissolved Bone	2821	0.0	0.0	14.0		
Cumberland Dissolved Bone Phosphate	2822	0.0	0.0	14.0		
" Bone and Potash	2823	0.0	2.0	10.0		
" Guano	2824	1.0	2.0	8.0		
" Hawkeye Fertilizer	2825	0.8	1.0	7.0		
" Acid Phosphate	2826	0.0	0.0	10.0		
" Potato Phosphate	2827	0.8	4.0	8.0		
Ground Bone	2870	2.4				20.0
Standard Bone and Potash	2871	0.0	2.0	10.0		
" "A" Brand	2872	0.8	1.0	7.0		
" Ammoniated Dissolved Bone	2873	1.6	2.0	8.0		
" Guano	2874	1.0	2.0	8.0		
" Dissolved Bone Phosphate	2883	0.0	0.0	14.0		
" Acid Phosphate	2884	0.0	0.0	10.0		

Brands Registered Under Act of March 11, 1901.—Continued.

LABEL	Official Number	Guaranteed by the Manufacturers to contain not less than				
		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
American Agri. Chem. Co., The, New York, N. Y.						
Williams & Clark Dissolved Bone and Potash	2875	0.0	2.0	10.0		
" " Dissolved Bone Phosphate.	2876	0.0	0.0	10.0		
" " Corn and Wheat Special..	2877	0.8	1.0	10.0		
Williams & Clark Prolific Crop Producer....	2878	0.8	1.0	7.0		
Reese Challenge Phosphate.....	2879	0.8	2.0	8.0		
" Half and Half.....	2880	0.8	1.0	7.0		
" Elm Phosphate.....	2881	0.0	0.0	14.0		
" Crown Phosphate and Potash.....	2882	0.0	2.0	11.0		
Mace's Dissolved Bone Phosphate and Potash	3547	0.0	1.0	13.0	1.0	
Special Bone Meal	3600	1.2				25 0
Indiana Onion and Truck Fertilizer.....	3755	0.8	10.0	6.0	2.0	
American Agricultural Chemical Co., The, Great Eastern Fertilizer Branch, Rutland, Vt.						
Great Eastern Dissolved Bone	3450	0.0	0.0	14.0	2.0	
Great Eastern English Wheat Grower.....	3451	0.8	2.0	8.0	1.0	
Great Eastern Vegetable Vine and Tobacco..	3452	2.0	3.0	8.0	1.0	
Great Eastern Soluble Bone and Potash....	3453	0.0	2.0	10.0	1.0	
Great Eastern Columbus Special	3454	0.0	0.0	10.0	2.0	
Great Eastern Corn Fertilizer	3455	1.6	2.0	8.0	1.0	
Great Eastern Unammoniated Wheat Special	3456	0.0	0.0	12.0	2.0	
M. E. Wheeler & Co., Branch of the American Agricultural Chemical Co., New York, N. Y.						
Wisdom's Choice	3092	0.0	0.0	10.0	2.0	
Unammoniated Wheat Grower	3093	0.0	0.0	12.0	2.0	
Electrical Dissolved Bone	3094	0.0	0.0	14.0	2.0	
Wheat and Clover Fertilizer.....	3095	0.0	2.0	10.0	1.0	
Royal Wheat Grower	3096	0.8	2.0	8.0	1.0	
Corn Fertilizer	3097	1.6	2.0	8.0	1.0	
Potato Manure	3098	2.0	3.0	8.0	1.0	
American Reduction Co., Pittsburg, Pa.						
Common Sense	3137	1.6	0.5	5.0	0.5	
Pittsburg Guano	3138	0.8	0.5	7.0	0.5	
Iron City.....	3139	2.0	1.5	7.5	0.5	
Century Bone and Potash	3751	1.0	3.5	6.5	0.5	
Armour Fertilizer Works, The, Chicago, Ill.						
Raw Bone	2903	3.7				22.0
Bone Meal	2904	2.4				24.0
Fruit and Root Crop Special.....	2906	1.6	5.0	8.0	2.0	
All Soluble	2907	2.8	4.0	8.0	2.0	
Star Phosphate	2908	0.0	0.0	14.0	2.0	
Phosphate and Potash	2909	0.0	2.0	10.0	2.0	
Grain Grower	2910	1.6	2.0	8.0	2.0	
Ammoniated Bone with Potash.....	2911	2.4	2.0	6.0	2.0	
Wheat, Corn and Oat Special	2938	0.8	1.0	7.0	2.0	
Bone, Blood and Potash	2958	4.1	7.0	8.0	2.0	
Acid Bone Meal	3020	1.6	0.0	11.0	7.0	
German Kainit	3312	0.0	12.5	0.0	0.0	
Armour's Steamed Bone	3331	1.6				20.0
Lawn and Garden	3339	2.8	4.0	8.0	2.0	
Cereal Phosphate	3360	0.0	0.0	10.0	2.0	
Muriate of Potash	3477	0.0	48.0	0.0	0.0	
Nitrate of Soda	3478	15.6	0.0	0.0	0.0	
Sulphate of Potash	3479	0.0	50.0	0.0	0.0	
Hoosier Corn Grower	3480	0.8	4.0	8.0	2.0	
High Grade Potato	3509	1.6	10.0	8.0	2.0	
Armour Standard	3510	0.8	3.0	8.0	2.0	
Soluble Phosphate and Potash	3536		4.0	10.0		
Royal Brand	3709	0.4	2.5	8.0		
Crop Grower	3710	1.2	2.0	8.0		
Banner Brand	3729		8.0	10.0		

Brands Registered Under Act of March 11, 1901.—Continued.

LABEL	Official Number	Guaranteed by the Manufacturers to contain not less than				
		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
Bash Packing Co., Fort Wayne, Ind.						
Potato and Garden Phosphate	2960	2.2	10.5			8.8
Utility Brand Superphosphate	2988	2.9	1.5	9.0	2.7	
Paragon Brand Superphosphate	2989	4.0	2.2	9.6	3.7	
Wayne Raw Bone	2990	4.0				21.8
Bone Phosphate	3176	0.0	3.0	11.0	1.5	
Utility Phosphate	3449	1.8	1.5	10.5	3.3	
Bash's Raw and Acidulated Bone	3476	2.0	0.0	19.0	5.0	
Bash's Grain Grower	3598	1.2	2.0	8.0	1.0	
Bash's Potash Special	3599		4.0	10.0	1.0	
Bash's 16 per cent. Phosphate	3604			16.0	1.0	
Bash's 14 per cent. Phosphate	3605			14.0	1.0	
Bash's 10 per cent. Phosphate	3606			10.0	1.0	
Bash's Blood, Bone and Potash	3667	2.0	2.0	8.0	1.0	
Monarch Plant Food	3668	4.0	7.0	6.0		
Bash's Onion Grower	3717	1.5	8.0	8.0	1.0	
Kainit	3748		12.4			
Nitrate of Soda	3749	15.5				
Bausback & Sons, Robert, Shelbyville, Ind.						
Genuine Wheat Grower	3006	2.3		6.5	9.0	
Soft Bone	3007	3.5				14.0
Fine Raw Bone	3008	3.5				22.0
Bolles, W. R., Ewing, Ind.						
Bolles Raw Bone	3633	3.7				22.0
Bolles Bone Meal	3634	2.4				24.0
Bolles Steamed Bone	3635	1.6				20.0
Bolles Complete Fertilizer	3636	1.6	2.0	8.0		
aBowker Fertilizer Co., Boston, Mass.						
Bowker's Bone Meal	2953	1.5				20.0
" Fish Guano	2954	0.7	3.0	8.0	1.0	
" Dissolved Bone Phosphate	2955	0.0	0.0	10.0	1.0	
" Soluble Bone	2956	0.0	0.0	14.0	1.0	
" Harvest Bone	3287	0.7	1.0	8.0	0.0	
" Potash Fertilizer	3311	0.0	5.0	10.0	1.0	
" Dissolved Bone with Potash	3459	0.0	2.0	10.0	1.0	
" 10 per cent. Manure	3460	0.7	10.0	5.0	1.0	
" Tobacco Grower	3730	1.6	5.0	8.0	2.0	
[1]Buckeye Fertilizer Co., The, Columbus, Ohio.						
Buckeye Bone Meal	3086	1.6				20.0
Buckeye Wheat Maker	3087		2.0	10.0		
Complete Fertilizer	3088	0.4	2.5	8.0		
Extra Superphosphate	3089			14.0		
Our Special Corn and Wheat Grower	3372	0.8	1.0	10.0	1.0	
Special Blood and Potash Mixture	3616	0.8	4.0	8.0	2.0	
Grain and Grass Grower	3617	0.8	1.0	7.0	2.0	
Fish Scrap and Potash	3750	1.6	2.0	8.0	2.0	
Buhner, Ferdinand, Seymour, Ind.						
Buhner's All Crop Grower	3316	2.0	1.2	8.0	2.0	
Ammoniated Ground Bone	3327	2.0				17.0
Buhner's Dissolved Bone	3486	0.0	0.0	14.0		
Farmers Favorite	3736	0.8	4.2	8.5	2.0	
Chicago Fertilizer Co., The, Chicago, Ills.						
Chicago Bone Meal	3009	1.6				20.0
Bone, Blood and Potash	3011	1.2	2.0	8.0	2.0	

aIncludes brands registered by Bowker Fertilizer Co., Cincinnati, Ohio, and New York, N. Y.
[1]Includes brands registered by the Buckeye Phosphate Co., Columbus, Ohio.

Brands Registered Under Act of March 11, 1901.—Continued.

LABEL	Official Number	Guaranteed by the Manufacturers to contain not less than: Per Cent. of Nitrogen (N)	Per Cent. of Potash (K2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
Chicago Fertilizer Co., The. Chicago, Ills.						
Potato, Truck and Tobacco Fertilizer	3215	1.6	4.0	8.0	1.0	
Wheat and Corn Special	3216	0.8	1.0	7.0	1.0	
Chicago Raw Bone	3353	1.2	0.0	0.0	0.0	27.0
"A" No. 1 Acid Phosphate	3409			10.0	1.0	
Diamond Phosphate	3410			14.0	1.0	
"A" Calumet Phosphate	3411		1.0	11.0	1.0	
Western Bone Black and Potash	3412	0.4	2.5	8.0	1.0	
No. 1 Calumet Phosphate	3712		2.0	10.0	1.0	
[2]Cincinnati Phosphate Co., The, St. Bernard, O.						
Capital City Ground Bone	2885	2.8				20.0
" " Wheat Grower	2886			14.0	1.0	
" " Grain and Grass Grower	2887	0.8	1.0	10.0	1.0	
" " Dissolved Bone and Potash	2888		3.0	12.0	1.0	
Capitol Tobacco Food	3224	0.8	4.0	8.0	1.0	
" Muriate Potash	3322		50.0			
" Alkaline Bone	3434		2.0	10.0	1.0	
" Nitrate of Soda	3506	13.5				
High Grade Guano	3571	0.8	2.0	10.0	1.0	
Tankage	3625	8.3				
Patrons High Grade Phosphate	3626			16.0	1.0	
Bonus, "A" Humus Phosphate	3699	0.2		14.0	1.0	
Bone and Phosphate Mixture, Wheat Special.	3700	1.6	1.0	10.0	6.0	
[3]Continental Fertilizer Co., Nashville, Tenn.						
Bear High Grade Potato and Tobacco Grower	3283	1.6	4.0	7.0	1.0	
" Raw Bone	3299	2.4				20.0
" Bone Meal	3300	0.8				20.0
" Special Wheat Grower	3328	0.8	1.0	7.0	1.0	
Bear Indiana Phosphate	3335			12.0	1.0	
" " Potash Mixture	3336		2.0	10.0	1.0	
" " Dissolved Bone	3337			14.0	1.0	
" " Special Corn Grower	3426	0.8	1.0	7.0	1.0	
" " Beef Blood and Bone	3427	1.6	2.0	10.0	1.0	
XX Ground Bone	3524	1.2		4.0	11.0	
Bear Slaughter House Bone	3672	1.6	2.0			9.0
" Bone and Potash	3746		4.0	10.0	1.0	
Corya, J. W., North Vernon, Ind.						
Pure Bone Meal	3356	2.0				24.0
Acidulated Bone Meal	3357	2.4	0.0	9.0	2.0	
Grain Grower	3358	0.0	2.0	10.0	1.0	
Critchfield Co., The Cincinnati, Ohio.						
Wheat and Grass Phosphate	3647		2.0	10.0	1.0	
Fish Guano	3648	1.2	2.0	9.0	1.0	
Standard Phosphate	3649			14.0	1.0	
Complete Plant Food	3752	0.8	1.0	10.0	1.0	
Currie Fertilizer Co., The, Louisvilc. Ky.						
Currie's Soluble Bone	2975	1.0	1.5	10.0	2.0	
" Acid Phosphate	3114			13.5		
" Alkaline Bone	3115		2.0	10.0	1.0	
" Corn and Wheat Special	3116	0.8	1.0	10.0	2.5	
" Kentucky Phosphate	3117	1.0	1.5	10.0	2.5	
" Wheat Grower	3118	1.0	1.5	10.0	2.5	
" Fine Ground Raw Bone Meal	3120	1.6				15 0
Darling & Company, Chicago, Ills.						
Darling's Ground Raw Bone	2843	3.3				21.0
" Two and Twenty Bone	2844	1.6				18 0

[2]Includes brands registered by Cincinnati Phosphate Co Cincinnati, Ohio.
[3]Includes brands registered by Continental Fertilizer Co., Louisville, Ky.

Brands Registered Under Act of March 11, 1901.—Continued.

LABEL	Official Number	Guaranteed by the Manufacturers to contain not less than				
		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
Darling & Company, Chicago, Ills.						
" Western Brand	2846	0.4	0.5	7.0		
" Chicago Brand	2847	1.6	2.0	8.0		
" Vegetable and Lawn Fertilizer	2848	3.3	7.0	8.0		
" Farmer's Favorite Brand	2849	2.4	4.0	8.0		
" High Grade Acid Phosphate	3244			14.0		
" Acid Phosphate	3245			10.0		
Sure Winner Brand	3280	0.8	3.0	8.0		
Pure Ground Bone	3281	2.4				23.0
Sulphate of Potash	3504		48.0			
D. & K. Fertilizer Co., Indianapolis, Ind.						
Quick Acting Wheat and Corn Grower	2928	1.5	1.9	10.0	1.0	
D. and K. Dissolved Bone and Potash	3019	1.3	2.1	7.1	2 1	
" " Fine Ground Bone	3026	2.5				20.0
" " Wheat Fertilizer	3027	1.7	1.5	8.0	2.2	
" " Potato and Tobacco Grower	3028	1.9	4.5	6.8	3.0	
" " Acidulated Bone	3029	1.6		8.3	9.5	
" " Bone Phosphate	3030		1.1	10.0	1.0	
" " Grain and Clover	3214	1.0	1.0	7.0	1.0	
Dissolved Bone with Potash	3362	0.8	1.1	7.0	1.0	
Pure Ground Bone	3363	1.6				20.0
Quick Acting Corn Grower	3402	0.8	1.5	9.0	0.5	
D. and K. Potato Grower	3495	0.4	2.0	6.0	1.0	
D. & K. Wheat Grower	3753	1.0	1.5	8.0	1.2	
Dryfus Packing & Provision Co., LaFayette, Ind.						
Star Brand	2922	4.5				16.0
Empire Carbon Works, National Stock Yards, Ill.						
Empire Raw Bone Meal	2986	3.2				22.0
Empire Guano Co., The, Nashville, Tenn.						
Empire High Grade Acid Phosphate	3307			14.0	2.0	
" Dissolved Bone	3308			10.0	2.0	
" Bone and Potash	3309		2.0	10.0	2.0	
" Wheat and Corn Grower	3310	0.8	1.0	10.0	1.0	
" Ground Bone	3440	2.4				17.0
" Guano	3441	1.6	2.0	8.0	2.0	
" Potash Mixture	3507		4.0	10.0	2.0	
Empire Climax Acid Phosphate	3514			16.0	1.0	
Ewing, George M., Greensburg, Ind.						
Ewing's Phosphate and Potash	3324		2.0	10.0		
" Best Phosphate and Potash	3325		2.0	12.0		
" Acid Phosphate	3326			10.0		
" Potash Mixture	3498		4.0	10.0	2.0	
" Complete Fertilizer	3619	0.8	1.0	7.0		
" 14% Acid Phosphate	3733			14.0		
Everitt, J. D., Seedsman, Indianapolis, Ind.						
Economy Pulverized Bone and Potash	3142		2.0	10.0	2.0	
Economy Ammoniated Pulverized Bone & Potash	3143	1.6	2.0	8.0	2.0	
Farmers' Fertilizer Co., Indianapolis, Ind.						
Farmers' Eureka Phosphate	3198			10.0		
" Wheat and Oats Special	3199			14.0		
" Phosphate and Potash	3200		2.0	10.0		
" Half and Half	3204	2.0		8.5	6.0	
" Pure Bone Meal	3205	2.4				22.0
L. R. Shepherd's Helpmate Wheat and Grass Grower	3282	1.1		8.5	2.5	
Electric Guano	3315		4.0	10.0		

Brands Registered Under Act of March 11, 1901.—Continued.

LABEL	Official Number	Guaranteed by the Manufacturers to contain not less than				
		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
Farmers' Fertilizer Co., Indianapolis, Ind.						
Farmers' Acidulated Bone Black	3392			16.0		
Farmer's Harvest King	3393	1.1	5.0	8.5	2.5	
Our Universal Phosphate	3555	0.8	1.0	7.0	1.0	
Corn and Wheat Grower	3556	0.8	2.0	8.0	1.0	
Our German Phosphate	3557	0.8	3.0	8.0	1.0	
Muriate of Potash	3716		50.0			
Flower City Plant Food Co., Rochester, N. Y.						
Walker's Excelsior Brand "Plant Food"	3364	7.0	11.0			12.0
Fox Chemical Co., Louisville, Ky.						
Fox Grain Grower	2728	0.8	1.0	9.0		
" Wheat and Corn Grower	2729	1.6	2.0	10.0		
" Alkaline Bone	2731		2.0	10.0		
" Acid Phosphate	2732			14.0		
A. A. Acid Phosphate	2733			10.0		
Fox Bone and Potash	2734		1.0	9.0		
" Grain Special	3111	0.4	1.5	9.0	1.0	
" Ground Bone	3112	2.4				22.7
" High Grade Acid Phosphate	3607			16.0		
" Bone Phosphate	3609		2.0	12.0		
" Vegetable Grower	3651	1.6	5.0	8.0		
" Early Bell	3669	0.8	2.0	10.0		
"A" Fox Formula	3675	0.8	3.0	11.0		
Fox Raw Bone	3684	3.2				22.0
" Standard Acid Phosphate	3685			12.0		
" Bone Phosphate and Potash	3686		4.0	10.0		
Muriate of Potash	3687		50.0			
Fox Bone Blood and Potash	3688	0.3	1.0	11.0		
" Wheat and Grain Special	3689	0.8	1.0	12.0		
Fritch & Bennett, Greenfield, Ind.						
Pure Soft Bone	3546	4.0				15.0
Globe Fertilizer Co., Louisville, Ky.						
Acorn Acid Phosphate	2719			10.0		
Globe Acid Phosphate	2720			14.0		
Big Four Phosphate	2721		1.0	8.0		
Globe Bone Dust	2723	0.8	1.0	9.0		
Globe Bone and Potash	2724	0.3	1.0	11.0		
Globe Wheat Grower	2725	1.6	2.0	10.0		
Eagle Corn and Wheat Grower	2727	1.6	2.0	8.0		
Globe Grain Grower	3109	0.4	1.5	9.0	1.0	
Acorn Bone Meal	3110	2.4				22.7
Golden Harvest Bone Meal	3173	2.4		10.0	1.0	
Globe High Grade Acid Phosphate	3608			16.0		
Globe Raw Bone	3643	3.7				22.0
Globe Potato Grower	3644	3.2	4.0	8.0		
Globe Progress Corn and Wheat Grower	3670	0.8	2.0	10.0		
"A" Braden Formula	3674	0.8	3.0	11.0		
Standard Acid Phosphate	3676			12.0		
Potash Compound	3677		2.0	12.0		
Potash Special	3678		2.0	10.0		
Globe Bone Phosphate and Potash	3679		4.0	10.0		
Wheat and Grain Special	3680	0.8	1.0	12.0		
Big Four Tobacco Grower	3681	1.6	2.0	8.0		
Globe Soluble Vegetable Manure	3682	1.6	5.0	8.0		
Globe Special Tobacco Grower	3683	2.4	10.0	8.0		

Brands Registered Under Act of March 11, 1901.—Continued.

LABEL	Official Number	Guaranteed by the Manufacturers to contain not less than				
		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
Hardy Packing Co., Chicago, Ills.						
Hardy's Bone Meal	3014	1.6				20.0
" Tobacco and Potato Special	3219	1.6	4.0	8.0	1.0	
" Tankage Bone and Potash	3220	1.2	2.0	8.0	1.0	
" Corn and Wheat Grower	3221	0.4	2.5	8.0	1.0	
" No. 1 Crop Producer	3222	0.8	1.0	7.0	1.0	
" Packers Raw Bone	3354	1.2				27.0
Security Phosphate	3414			14.0	1.0	
Ft. Dearborn Phosphate	3415			10.0	1.0	
No. 1 Phosphate and Potash	3713		2.0	10.0	1.0	
Heck & Co., Henry, Cannelton, Ind.						
Hecks Special Corn and Wheat Grower	3519	0.8	1.0	7.0	2.0	
Heck's Raw Bone	3520	3.7				22.0
Heck's Bone Meal	3521	2.4				24.0
Hess & Bro., S. M., Philadelphia, Pa.						
Keystone Bone Phosphate	2991	0.8	1.0	8.0	2.0	
Special Compound	2992	0.8	4.0	8.0	1.0	
Wheat and Grass Manure	2993	0.8	2.0	8.0	1.0	
Soluble Bone Phosphate	2994			14.0	2.0	
Ground Bone	2995	3.2				20.0
Ammoniated Bone Superphosphate	3170	1.6	2.0	8.0	1.0	
Special Corn Manure	3278	0.8	2.0	8.0	1.0	
Potato and Truck Manure	3279	2.5	6.0	8.0	1.0	
Soluble Bone and Potash	3291		2.0	10.0	1.0	
Acid Phosphate	3535			12.0	2.0	
Tobacco Manure	3621	2.4	6.0	8.0	2.0	
Hopkins & Co., A., New Albany, Ind.						
Half and Half	2923	1.8	1.7	6.1	6.4	
Hopkins Old Times Bone and Potash	3133	0.8	2.1	5.6	0.5	
Hopkins Fertilizer Co., New Albany, Ind.						
Muriate of Potash	3330		50.0			
Hopkins "Old Times Special Crop Grower"	3374	1.0	6.0	8.5		
" " " Bone Meal	3428	3.0				17.0
" " " Wheat & Corn Grower	3429	1.0	2.0	8.5		
" " " Pure Raw Bone	3430	3.5				21.5
" " " Bone and Potash	3431		2.0	10.0		
" " " Phosphate	3432			13.0		
" " " Half and Half	3433	2.0	2.0	6.0	6.0	
" " " Fine Ground Bone	3664	2.0				28.0
Hubbard Fertilizer Co., Baltimore, Md.						
Hubbard's Truckers' 7 per cent. Royal Seal Compound	3228	5.7	5.0	6.0	1.5	
Hubbard's Royal Ensign	3229	2.4	4.0	8.0	1.5	
" Standard Bone Super-Phosphate	3230	1.6	3.0	8.0	1.5	
" Farmer's I. X. L. Super-Phosphate	3231	1.6	2.0	8.0	1.5	
" Wheat Growers' Jewel	3232	1.2	2.0	9.0	1.5	
" Oriental Phosphate	3233	0.8	1.0	8.0	1.0	
" Columbia Gem Phosphate	3234	0.4	1.0	8.0	1.0	
" Soluble Bone and Potash	3235		2.0	10.0	1.0	
" High Grade Soluble Tennessee Phosphate	3236			14.0	1.0	
" Crescent Soluble Crop Producer	3237			10.0	2.0	
" Pure Raw Bone Meal	3276	2.8				22.5
Hubbell & Son Fertilizer Co., L. W., Francesville, Ind.						
Hubbell's Corn and Clover Grower	3627		4.0	10.0		
Hubbell's Special Corn Grower	3628		6.0	8.0		
Kainit	3641		12.0			

Brands Registered Under Act of March 11, 1901.—Continued.

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Hubbell & Son Fertilizer Co., L. W., Francesville, Ind.						
Muriate of Potash	3642		50.0			
Hubbell's Grain King	3694	0.8	7.0	6.0		
" Hoosier High Grade Potash and Tankage	3743	0.4	10.0			5.0
" Hercules 10% Potash	3744		10.0	5.0		
Hull Samuel, Liberty, Ind.						
Hull's General Crop Grower	3508	1.2	3.0			14.0
Indianapolis Fertilizer Co., Indianapolis, Ind.						
Corn Special	3292	1.2	2.1	9.1	1.1	
Soluble Bone	3293			12.0	0.8	
Wheat Special	3294	1.5	1.3	7.5	1.2	
Bone, Blood and Potash	3295	1.3	1.9	7.1	1.5	
Raw Bone	3296	1.9				20.0
Corn and Wheat Special	3394	0.8	1.5	8.0	0.7	
Bone and Blood With Potash	3395	1.1	0.8	7.0	0.7	
Indianapolis Rendering Co., Indianapolis, Ind.						
Banner Bone	3258	2.4				25.0
Half and Half	3259	2.0		8.0	6.0	
Phosphate and Potash	3263		2.0	10.0		
Super-Phosphate	3264			14.0		
Union Phosphate	3265			10.0		
Potash Special	3361		4.0	10.0		
Banner Bone Black	3391			16.0		
Our Grain Grower	3561	0.8	1.0	7.0	1.0	
Corn and Wheat Grower	3562	0.8	2.0	8.0	1.0	
Our Bone and Potash	3563	0.8	3.0	8.0	1.0	
Jarecki Chemical Co., Sandusky, Ohio.						
Pure Ground Bone	2912	2.4				20.0
Dissolved Bone With Potash	2913		3.0	12.0	1.0	
Fish and Potash Potato and Tobacco Food	2914	0.8	4.0	8.0	1.0	
O. K. Fertilizer	2915	0.4	0.5	5.0	1.0	
Jarecki Chemical Co., Sandusky, Ohio.						
C. O. D. Phosphate	2918			14.0	1.0	
Fish and Potash Grain Special	2919	1.2	2.0	9.0	1.0	
Number One Fish Guano	2920	0.8	1.0	10.0	1.0	
Square Brand Phosphate and Potash	3458		2.0	10.0	1.0	
Lake Erie Guano	3475	0.8	2.0	10.0	1.0	
Perfection Tomato Grower	3640	0.8	5.0	8.0	1.0	
Raw Bone and Guano Mixture	3696	1.6	1.0	10.0	6.0	
Norris Steamed Bone Meal	3718	2.5				20.0
Norris Soluble Bone Phosphate	3719			14.0	1.0	
Norris Bone and Potash	3720		2.0	10.0	1.0	
Norris High Grade Bone and Potash	3721		4.0	10.0	1.0	
Norris Electric Wheat Maker	3722		2.5	12.0	1.0	
Norris Half and Half	3723	1.6	1.0	10.0	6.0	
Norris Special Fish Guano	3724	1.0	2.0	8.0	1.0	
Johnson D. B., Mooresville, Ind.						
D. B. Johnson's Pure Ground Bone	3349	2.4				22.0
D. B. Johnson's Dissolved Bone Phosphate	3350			14.0		
D. B. Johnson's Dissolved Bone Black	3533			16.0		
Jones, J. B., Louisville, Ky.						
Raw Bone	2933	3.5				21.5
Corn Grower	2935	2.4	0.9	9.0	2.0	
Wheat Grower	3067	1.7	2.0	9.0	2.0	

Brands Registered Under Act of March 11, 1901.—Continued.

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		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K_2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
Jones, J. B., Louisville, Ky.						
Tobacco and Potato Grower	3288	2.8	5.5	10.0	2.0	
J. B. Jones Special Wheat Grower	3522	2.4	2.0			10.0
Jones Corn Grower	3652	2.4	2.0	9.0	2.0	
" Tobacco and Potato Grower	3653	2.8	5.0	10.0	2.0	
" Wheat Grower	3654	1.7	2.0	9.0	2.0	
Jones Robin, Nashville, Tenn.						
Ground Phosphate Rock	3551					28.0
[4]Jones Fertilizing Co., Louisville, Ky.						
"Jones" Miami Valley Phosphate	3289	1.6	2.0	10.0	2.0	
High Grade Dissolved Bone	3347			14.0	1.0	
Potash Mixture	3348		2.0	10.0	1.0	
Jones Corn and Wheat Grower	3565	0.8	1.0	7.0	1.0	
Jones Tobacco and Potato Grower	3566	1.6	4.0	7.0	1.0	
Indiana Jones Reliable	3567	0.8	1.5	8.0	1.0	
Jones Phosphate	3568			12.0	1.0	
Jones Bone Meal	3569	0.8				20.0
Jones Raw Bone	3570	2.4				20.0
Jones Slaughter House Bone	3673	1.6	2.0			9.0
Kaufman Fertilizer Co., Cincinnati, Ohio.						
Pure Bone	3701	2.2				20.0
Acid Phosphate	3702			14.0	1.0	
Half and Half	3703	1.6	1.0	10.0	6.0	
Special Wheat Fertilizer	3704	1.6	2.0	8.0		
Harvest King	3705	1.0	2.0	8.0	1.0	
Special Potato and Tobacco Fertilizer	3706	1.6	6.0	6.0	1.0	
Banner Crop Grower	3707	0.8	1.0	7.0	1.0	
Alkaline Bone and Potash	3708		2.0	10.0	1.0	
Lawn Sundries Co., South Bend, Ind.						
Lawn Food	2977	1.0	2.0			7.5
Libby, McNeill & Libby, Chicago, Ills.						
Libby's Peerless Fertilizer	3655	2.4	5.0	8.0	3.0	
" Highlands Fertilizer	3656	1.6	7.0	8.0	3.0	
" Cabbage Grower	3657	2.5	3.0			23.5
Lister, Joseph, Chicago, Ill.						
Pure Bone Meal	3141	2.5				25.0
Louisville Fertilizer Co., Louisville, Ky.						
Bone Meal	2785	0.8		3.0	17.0	
Special Wheat Grower	2786	0.8	1.0	7.0	1.0	
Soluble Bone	2788	0.8	1.5	8.0	1.0	
High Grade Tobacco and Potato Grower	2791	1.6	4.0	7.0	1.0	
Melon Special	2936	0.8	1.5	8.0	1.0	
Eagle Raw Bone	3297	2.4				20.0
Eagle Indiana High Grade Dissolved Bone	3340			14.0	1.0	
" Indiana Potash Mixture	3341		2.0	10.0	1.0	
" Guano	3423	1.6	2.0	10.0	1.0	
" Indiana Special Corn Grower	3424	0.8	1.0	7.0	1.0	
Tanking	3500	5.0				12.0
Nitrate of Soda	3501	15.0				
Sulfate of Potash	3502		48.0			
Muriate of Potash	3503		50.0			
XX Ground Bone	3523	1.2		4.0	11.0	
Eagle Indiana Phosphate	3564			12.0	1.0	
" Slaughter House Bone	3671	1.6	2.0			9.0
" Bone and Potash	3745		4.0	10.0	1.0	

[4]Includes brands registered by The Jones Fertilizing Co., Cincinnati, Ohio.

Brands Registered Under Act of March 11, 1901.—Continued.

LABEL	Official Number	Guaranteed by the Manufacturers to contain not less than				
		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
Mace, Geo. W., Greenville, Ohio.						
Dissolved Bone and Potash	3164		1.0	12.0		
Big Crop Bone Phosphate and Potash	3165		3.0	10.0		
Madison Fertilizer & Glue Works, Madison, Ind.						
Valley City Corn Grower	2929	2.0	1.0	8.0	3.5	
" " Wheat Grower	3151	2.0	1.0	8.0	3.5	
Madison City Raw Bone Meal	3152	3.4				18.0
Mathiason M'f'g Co., P. B., St. Louis, Mo.						
Increscent Brand Raw Bone Meal	3046	3.2				20.0
Increscent Brand Fine Ground Bone Meal	3047	2.5				20.0
Increscent Brand Extra Fine Ground Bone Meal	3048	2.2				20.0
Increscent Brand St. Louis Fertilizer	3049	1.5	1.5	7.0	2.0	
Increscent Acid Phosphate	3050			14.0	2.0	
Increscent Brand Acidulated Bone and Potash	3051	2.2	2.0	8.0	2.0	
Increscent Brand Acidulated Bone Meal	3052	2.5		10.0	4.0	
Increscent Brand Grain Grower	3658	1.7	1.5	8.0	2.0	
Mayer M'f'g Co., A. B., St. Louis, Mo.						
Anchor Brand Pure Bone Meal	2779	3.0				20.0
Anchor Brand St. Louis Bone Meal	2780	2.5				16.0
Anchor Brand Pure Acid Phosphate	2781			12.0		
Anchor Brand Bone and Potash	2782	2.0	1.0	5.0	3.0	
Anchor Brand Corn and Wheat Grower	2783	2.5	2.0	6.0	4.0	
Anchor Brand Complete Fertilizer	2784	1.5	1.0	6.0	4.0	
Mehring, Frederick, Bruceville, Md.						
Twenty-Six-Dollar Phosphate	3660	1.2	1.0	12.0	1.0	
Mendenhall & Spilman, Greensburg, Ind.						
M. & S. Grain Grower	3661		2.0	10.0		
M. & S. Decatur County Special	3662		4.0	10.0		
Mertz, Thomas, Richmond, Ind.						
Common Sense Bone Meal	2937	2.5				8.5
Myers Elevator Co., Jacob, Francesville, Ind.						
Ideal Phosphate	3737			10.0		
Phosphate and Potash	3738		4.0	10.0		
Soluble Bone	3739	0.8	1.0	7.0	1.0	
Grain Grower	3740	0.8	2.0	8.0	1.0	
Michigan Carbon Works, Detroit, Mich.						
Wolverine Ground Bone	2894	1.6				25.0
Desiccated Bone	2895	1.2				25.0
Homestead A. B. B. Fertilizer	2896	2.0	1.5	8.0		
Homestead Potato and Tobacco Fertilizer	2897	2.0	3.0	8.0		
Red Line Complete Manure	2898	0.8	1.0	7.0		
Red Line Crop Grower	2899	1.6	2.0	8.0		
Red Line Phosphate	2900			14.0		
Wolverine Phosphate	2901			10.0		
Red Line Phosphate with Potash	2902		2.0	10.0		
Wolverine Pure Ground Bone	3448	2.4				20.0
Homestead Potato and Tobacco Special	3602	2.0	5.0	8.0	1.0	
Monarch Fertilizer Co., Fort Wayne, Ind.						
Monarch Pure Raw Ground Bone	3690	4.0				21.0
" Blood, Bone and Potash	3691	1.8	2.0	8.3	3.7	
" Grain Grower	3692	1.2	2.0	8.0	1.0	
" Superphosphate	3693	1.8	1.5	10.5	3.3	
" 10% Phosphate	3747			10.0	1.0	

Brands Registered Under Act of March 11, 1901.—Continued.

LABEL	Official Number	Guaranteed by the Manufacturers to contain not less than				
		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K_2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
Morris & Co., Nelson, Chicago, Ill.						
Big One	3021	3.2				24.0
Big Two	3022	2.0				28.0
Big Three	3023	2.5	2.0	4.0	6.0	
Big Four	3024	4.1	4.0	5.0	5.0	
Big 5	3025	2.5	1.0	4.0	5.0	
Big Six Special Bone Meal	3303	0.8				27.0
Big Seven High Grade Acid Phosphate	3304			10.0	1.0	
Big Eight Ammoniated Acid Phosphate with Potash	3305	0.8	1.0	10.0	1.0	
National Fertilizer Co., Nashville, Tenn.						
National Wheat Grower	3537	1.6	2.0	10.0	1.0	
Old Hickory Guano	3538	1.6	2.0	8.0	1.0	
Magic Plant Food	3580	4.1	5.0	10.0	1.0	
Ammoniated Dissolved Bone	3581	0.8	1.0	10.0	1.0	
Sadler's Formula	3582		2.0	12.0	1.0	
National Grain Grower	3583	1.6	2.0	8.0	1.0	
National Acid Phosphate and Potash	3584		2.0	10.0	1.0	
National High Grade Dissolved Bone	3585			14.0	1.0	
National Acid Phosphate	3586			12.0	1.0	
National Pure Raw Bone Meal	3587	3.3				22.5
National Steamed Bone Meal	3588	2.5				22.5
Special Blood and Bone Guano	3725	0.8	1.0	7.0	2.0	
Special Old Hickory Guano	3726	1.0	2.0	8.0	1.0	
New York and St. Louis Mining and M'f'g Co., St. Louis, Mo.						
St. Louis Acidulated Bone	3377			14.0	1.0	
St. Louis Acidulated Bone and Potash	3378		2.0	10.0	2.0	
Daisy Fertilizer	3379	1.6	2.0	8.0	2.0	
Norris Fertilizer Co., Rushville, Ind						
Norris High Grade Bone and Potash	3469		4.0	10.0		
Norris Bone and Potash	3470		2.0	10.0		
Norris Soluble Bone Phosphate	3471			14.0		
Norris Special Fish Guano	3472	1.2	2.0	8.0	2.0	
Norris X Rush County Special	3473			16.0		
Norris Electric Wheat Maker	3474		2.5	12.0	1.0	
Norris Steamed Bone	3632	3.0				20.0
North Western Fertilizing Co., Chicago, Ills.						
Horse Shoe Brand Pure Ground Bone	2857	2.4				20.0
" " " Fine Raw Bone	2858	3.2				22.0
" " " Potato Grower	2859	2.4	2.0	9.0		
" " " Corn and Wheat Grower	2860	1.6	2.0	8.0		
" " " Bone and Potash	2861		2.0	10.0		
" " " Melon Grower	2862	2.4	2.0	9.0		
" " " Acidulated Bone and Potash	2863	0.8	1.0	10.0		
" " " Acidulated Bone	2864	0.8		10.0		
" " " Quick Acting Phosphate	2865			10.0		
" " " National Bone Dust	2866	2.0	1.5	8.0		
" " " Garden City Super-Phos.	2867	2.0	1.5	8.0		
" " " Challenge Corn Grower	2868	2.0	1.5	8.0		
" " " Raw Bone and Super Phosphate Mixture	2869	2.4	0.5	7.0	6.0	
" " " Prairie Phosphate	3035	1.6		10.0		
" " " Ky-Ana. Phosphate	3036	0.8		6.0		
Muriate of Potash	3323		50.0			
Horse Shoe Brand Special Bone Meal	3517	1.2				25.0
Horse Shoe Brand Special Potato Grower	3601	2.0	5.0	8.0	2.0	

Brands Registered Under Act of March 11, 1901.—Continued.

LABEL	Official Number	Guaranteed by the Manufacturers to contain not less than				
		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
Ohio Farmers Fertilizer Co., Columbus, Ohio.						
Fine Ground Bone Meal	2944	1.6				20.0
Corn, Oats and Wheat Fish Guano	2947	1.2	2.0	8.0	2.0	
No. 1 Potato and Tobacco Special	3207	1.6	4.0	8.0	1.0	
Wheat Maker and Seeding Down	3208	0.4	2.5	8.0	1.0	
"A" General Crop Fish Guano	3306	0.8	1.0	7.0	1.0	
Raw Bone Meal	3351	1.2				27.0
"A" Superior Phosphate	3416			10.0	1.0	
Alkaline Bone	3417			14.0	1.0	
No. 1 Soluble Bone and Potash	3715		2.0	10.0	1.0	
Odorless Plant Food Co., Peru, Ills.						
Odorless Lawn Enricher	3090	1.5	8.0	8.0		
Packers Fertilizer Association, Chicago, Ills.						
Boars Head Brand Chicago Bone Meal	2851	2.4				20.0
" " " Ammoniated Bone & Pot.	2852	0.8	1.0	10.0		
" " " Potash Phosphate	2853		4.0	10.0		
" " " Sure Growth Phosphate	2854	0.8		10.0		
" " " Soluble Phosphate	2855			10.0		
" " " World of Good Super Phos	2856	2.0	1.5	8.0		
" " " Gilt Edge Phosphate	3277			14.0		
" " " Special Bone Meal	3518	1.2				25.0
Boar's Head Brand World of Good Potato and Tobacco Grower	3631	2.0	5.0	8.0	2.0	
Boar's Head Brand Corn and Wheat Grower	3727	1.6	2.0	8.0	2.0	
Packers Fertilizer Co., The, Cincinnati, Ohio.						
Animal Guano and Potash	3435	0.8	4.0	8.0	1.0	
Sweepstakes Bone	3436	0.8	2.0	10 0	1.0	
Acidulated Bone	3490			14.0	2.0	
Bone Phosphate	3491	0.8	1.0	10.0	1.0	
Acidulated Bone and Potash	3492		2.0	10.0	1.0	
Bone Meal	3493	2.5				20.0
Humus	3697	0.2		14.0	1.0	
Pure Bone with Phosphate and Potash	3698	1.6	1.0	10.0	6.0	
Packer Fertilizer Co., Indianapolis, Ind.						
Packer's Bone	3247	2.4				25.0
" Half and Half	3248	2.0		8.5	6.5	
" Phosphate and Potash	3252		2.0	10.0		
" Superphosphate	3253			14.0		
" Standard Phosphate	3254			10.0		
" Dissolved Bone	3266		4.0	10.0		
" Bone Black	3390			16.0		
Our Wheat Grower	3558	0.8	1.0	7.0	1.0	
Corn and Wheat Special	3559	0.8	2.0	8.0	1.0	
Our Complete Fertilizer	3560	0.8	3.0	8.0	1.0	
Our Leader	3590	0.8	5.0	8.0	0.0	
Pero & Stoecker, Louisville, Ky.						
Pure Potato Grower	3622	3.5	6.0			10.0
Pure Animal Matter Corn and Wheat Grower	3623	3.5				10.0
Pure Bone Meal	3624	3.2				22.0
Queen City Fertilizer Co., Cincinnati, Ohio.						
High Grade Wheat and Grass Grower	3511			14.0	1.0	
High Grade Corn and Wheat Grower with Potash	3512		2.0	10.0	1.0	
Valley Gem Phosphate	3540	0.8	1.0	10.0	1.0	
Miami Valley Grain Grower	3541	0.8	2.0	10.0	1.0	
Bone Meal	3542	2.5				20.0
Special Wheat Grower	3543			9.0	1.0	
Tobacco and Potato Grower	3618	0.8	4.0	8.0	1.0	

Brands Registered Under Act of March 11, 1901.—Continued.

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		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
E. Rauh & Sons Fertilizer Co., Indianapolis, Ind.						
Rauh's Ideal Phosphate	3185			10.0		
" Red Star Phosphate	3186			14.0		
" Phosphate and Potash	3189		2.0	10.0		
" Peerless Bone	3191	1.6	4.0	10.0		
" Special	3192	1.6	6.0	10.0		
" Half Pure Raw Bone and Half Pure Bone Phosphate	3193	1.2	0.0	8.5	11.0	
Rauh's Lawnmere	3194	1.0		8.5	10.0	
Rauh's Pure Ground Bone	3195	2.4				22.0
" Pig Foot Bone	3196	2.4				22.0
Sulfate of Potash	3197		48.5			
" Grain Grower	3302		4.0	10.0		
Rauh's Dissolved Bone Black	3389			16.0		
Potato Fertilizer	3505	0.8	8.0	10.0		
Our Soluble Bone	3552	0.8	1.0	7.0	1.0	
Corn and Wheat Grower	3553	0.8	2.0	8.0	1.0	
Our Dissolved Bone and Potash	3554	0.8	3.0	8.0	1.0	
Rauh's Tomatoe Fertilizer	3731	1.6	6.0	10.0		
Rauh's Formula For Muck Land	3741		8.0	10.0		
Nitrate of Soda	3742	15.6				
Read Phosphate Co., Nashville, Tenn.						
Read's Blood and Bone Fertilizer No. One	3037	1.6	2.0	8.0	1.0	
" Wheat and Clover Grower	3038	0.8	2.0	10.0	1.0	
" Dissolved Bone Phosphate	3039			10.0	1.0	
" High Grade Acid Phosphate	3040			14.0	1.0	
" XXX Dissolved Bone	3041			13.0	1.0	
" Bone and Potash	3042		2.0	10.0	1.0	
Fine Ground Bone	3043	2.0				20.2
Muriate of Potash	3044		49.0			
Nitrate of Soda	3045	14.7				
Read's Corn Grower Special	3284	0.8	1.0	10.0	1.0	
20 per cent. Manure Salts	3365		20.0			
McKee's Dissolved Bone Phosphate	3367			14.0	2.0	
Read's Ground Bone	3439	2.4				17.0
Scherman, Joseph, Jasper, Ind.						
Scherman's Mixed Raw Bone Meal	3181	1.3	0.4			12.0
Schmadel, Louis, Evansville, Ind.						
Schmadel's Bone Meal	2961	4.0				16.0
" Mixed Fertilizer	3371	2 0		8.0	8.0	
Shetterly, D. H., Franklin, Ind.						
Shetterly's Superphosphate	3318			10.0		
" Pure Ground Bone	3319	2.4				22.0
" Soluble Bone and Potash	3320	1.2	1.0	8.0		
" Dissolved Bone Phosphate	3321			14.0		
Smith Agricultural Chemical Co., (The) Columbus, Ohio.						
S. A. C. Co., Tankage	3637	9.0				
S. A. C. Co., Muriate of Potash	3638		49.0			
S. A. C. Co., Nitrate of Soda	3639	15.7				
S. A. C. Co. Tomato Grower	3711	0.8	7.0	8.0	1.0	
Smith, Wm. Jr., Columbus, Ind.						
Soft Bone Fertilizer	3131	5.0				15.0
Southern Indiana Fertilizer Co., Boonville, Ind.						
Premium Bone Meal	3123	1.0				28 0
Bone Meal	3124	0.7		8.0	10.0	
Soluble Bone	3125	1.2		10.0		

Brands Registered Under Act of March 11, 1901.—Continued.

LABEL	Official Number.	Guaranteed by the Manufacturers to contain not less than				
		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
Southern Indiana Fertilizer Co., Boonville, Ind.						
High Grade Acid Phosphate	3342			14.0		
Raw Bone Meal	3343	3.0				22.0
Muriate of Potash	3344		50.0			
Soluble Bone and Potash	3373	1.0	4.0	10.0		
Bone Meal	3659	2.0				20.0
Star Tankage & Fertilizer Works, Vincennes, Ind						
Star Raw Bone Meal	3382	2.9				20.0
Star Pure Bone Meal	3515	2.0				27.0
Star Grain Grower	3516	2.0		8.9	1.5	
"A" Star Wheat Grower	3663	4.0		5.1	5.8	
"A" Star Corn, Mellon and Potatoe Grower	3728	1.5	2.0	9.0	2.0	
Champion Mellon Grower	3734	2.0	4.0	8.0	2.0	
Stein, Hirsh & Co., Chicago, Ill.						
XXX Raw Bone Meal	2982	4.0				20.0
X Pure Ground Bone	2983	2.5				24.0
XXX Raw Bone Meal With Potash	2984	3.7	2.0			18.5
X Pure Ground Bone with Potash	2985	2.3	2.0			21.5
St. John, Charles E., Greensburg, Ind.						
Soft Bone Fertilizer	3132	3.0				17.0
Animal Matter	3359	3.0				14.0
Smith & Co., Emery J., Columbus, Ohio.						
Bone Meal	3054	1.6				20.0
Ammoniated Bone and Potash	3055	0.8	1.0	8.0	1.0	
Special Bone and Potash Mixture	3056	0.8	4.0	8.0	1.0	
Acid Phosphate	3057			9.0	1.0	
Swift & Company, Chicago, Ills.						
Swift's Superphosphate	2715	1.6	2.0	8.0	4.0	
" Garden City Phosphate	2716			14.0		
" Pure Raw Bone Meal	2755	3.7				23.0
" Bone Meal	2756	2.5				25.0
" Diamond S. Phosphate.	2757			10.0		
" Complete Fertilizer	2760	1.0	1.0	8.0	3.0	
" Ammoniated Bone and Potash	2761	4.7	3.0			16.0
" Bone and Potash	2762	2.5	3.0			23.5
" Ammoniated Bone	2924	5.0				17.0
Swift's Sugar Beet Grower	2925	2.5	5.0	8.0	3.0	
" Vegetable Grower	2927	3.2	10.0	9.0	1.0	
Swift's Lawn Fertilizer	3058	3.7				23.0
" Special Bone Meal	3084	0.8				27.5
Swift's Champion Wheat and Corn Grower	3443	1.6	2.0	12.0	1.0	
" Onion, Potato and Tobacco	3444	1.6	7.0	8.0	3.0	
" Special Phosphate and Potash	3445		2.0	10.0	1.0	
Swift's Bone Meal and Blood	3513	3.7				23.0
Swift's High Grade Muriate of Potash	3549		50.0			
Swift's Truck Grower	3603	0.8	4.0	8.0	2.0	
Tennessee Chemical Co., Nashville, Tenn.						
Ox Raw Bone	3298	2.4				20.0
" Bone Meal	3301	0.8				20.0
" Special Wheat Grower	3329	0.8	1.0	7.0	1.0	
" Indiana Dissolved Bone	3332			14.0	1.0	
" Indiana Phosphate	3333			12.0	1.0	
" Indiana Potash Mixture	3334		2.0	10.0	1.0	
" Indiana Alkaline Bone	3338		2.0	12.0	1.0	
" Indiana Special Corn Grower	3425	0.8	1.0	7.0	1.0	
" Indiana Slaughter House Bone	3442	1.6	2.0	8.0	1.0	
" Indiana Ammoniated Bone	3457	1.6	2.0	10.0	1.0	
Franklin County Wheat Grower	3531			16.0	1.0	
Ox Potash Formula	3735		4.0	10.0	1.0	

Brands Registered Under Act of March 11, 1901.—Continued.

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Tuscarora Fertilizer Co.., Chicago, Ills.						
Tuscarora Raw Bone	3461	3.7				22.0
Ammoniated Phosphate	3462	0.8	1.0	7.0	2.0	
Tuscarora Standard	3463	1.6	2.0	8.0	2.0	
Bone and Potash	3464		2.0	10.0	2.0	
Acid Phosphate	3465			14.0	2.0	
Animal Bone	3466	2.4				24.0
Tuscarora Potato	3467	1.6	10.0	8.0	2.0	
Tuscarora Acidulated Bone Meal	3496	1.6		11.0	7.0	
Tuscarora Steamed Bone	3530	1.6				20.0
Tuscarora Bone Phosphate	3539			10.0	2.0	
Acidulated Bone Meal and Potash	3545	1.6	3.0	12.0	6.0	
A. B. Norris Fertilizer Co., Brand, "Norris Bone Meal"	3610	1.6				20.0
A. B. Norris Fertilizer Co., Brand "Special Corn and Wheat"	3611	1.2	2.0	8.0	2.0	
A. B. Norris Fertilizer Co., Brand, "Soluble Dissolved Bone"	3612			14.0	2.0	
A. B. Norris Fertilizer Co.. Brand "Wheat and Clover"	3613			16.0	2.0	
A. B. Norris Fertilizer Co., Brand "High Grade Bone and Potash"	3614		4.0	10.0	2.0	
A. B. Norris Fertilizer Co.. Brand "Bone and Potash"	3615		2.0	10.0	2.0	
Tuscarora Garden	3629	2.8	4.0	8.0		
Big (4) Four	3630	1.6	4.0	7.0		
Tuscarora Trucker	3650	4.1	7.0	8.0		
Soluble Phosphate with Potash	3695		4.0	10.0		
Tuscarora Chief	3732	0.8	4.0	8.0		
German Kainit	3754		12.0			
Virginia-Carolina Chemical Co., Richmond, Va.						
Beef, Blood and Bone Fertilizer	3383	1.6	2.0	8.0	2.0	
Champion Corn and Wheat Grower	3384	0.8	2.0	8.0	2.0	
Royal Grain Grower	3385		4.0	10.0	2.0	
Capital Bone and Potash Compound	3386		2.0	10.0	2.0	
Capital Dissolved S. C. Bone	3387			12.0	2.0	
Walker, Stratman & Co., Pittsburg, Pa.						
Phosphoric Acid and Potash	2968		2.0	10.0		
Help Mate	2969			12.0		
Bone and Meat	2970	3.0				15.0
Pure Raw Bone Meal	2971	3.0				22.0
Big Bonanza	2972	1.5	4.0	8.0		
Grain King	2973	0.8	4.0	8.0		
Four Fold	2974	1.5	2.0	8.0		
Weidman, Augustus, Hagerstown, Ind.						
Wheat and Grass Grower	3135	1.5	1.7	9.0	1.5	
Weidman Acid Phosphate and Potash	3375		2.0	10.0		
Steamed Bone	3525	0.5				18.0
Nitrate of Soda	3526	14.0				
Muriate of Potash	3527		50.0			
Acid Phosphate	3528			16.0		
Western Fertilizer Works, Indianapolis, Ind.						
Wheat and Clover Grower	3396	1.2	1.5	8.0	1.0	
Wheat and Corn Special	3397	0.8	1.0	8.0	0.5	
Complete Fertilizer	3398	0.4	1.0	7.0	0.5	
Dissolved Bone and Potash	3399		2.0	8.0	0.5	
Acid Phosphate	3400			12.0	0.5	
Bone Meal	3401	1.7				20.0

Brands Registered Under Act of March 11, 1901.—Continued.

LABEL	Official Number	Guaranteed by the Manufacturers to contain not less than				
		Per Cent. of Nitrogen (N)	Per Cent. of Potash (K2O) Soluble in Water.	Per Cent. of Soluble and Reverted Phosphoric Acid.	Per Cent. of Insoluble Phosphoric Acid	Per Cent. of Total Phosphoric Acid.
Western Chemical Co., Chicago, Ills.						
Soluble Phosphate	3403			10.0	1.0	
Dissolved Bone	3404			14.0	1.0	
Acidulated Bone	3405		1.0	11.0	1.0	
Eureka Phosphate	3406	0.8	1.0	7.0	1.0	
Ground Bone	3408	1.2				27.0
"A" Standard Phosphate	3446	1.6	2.0	8.0	1.0	
The Wuichet Fertilizer Co., Dayton, Ohio.						
Spot Cash Fertilizer	3591	1.5	2.0	10.0	2.0	
Ruby Phosphate	3592	0.5	1.0	10.0	1.0	
Competitor Fertilizer	3593		0.5	10.0	1.0	
Onion and Truck Fertilizer	3594	1.5	8.0	8.0	1.0	
Raw Bone and Phosphate	3595	2.0	1.0	10.0	5.0	
Miami Phosphate	3596	1.0	3.0	9.0	1.0	
Superior Pure Raw Bone	3597	3.0				23.0
Yunker, Gus, Madison, Ind.						
The Madison Pride	3150	3.0				18.0
Jefferson County Pride	3548	1.9	7.5	9.9	3.3	

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